433-IRD-0003

GAMMA-RAY LARGE AREA SPACE TELESCOPE (GLAST) PROJECT

GLAST Spacecraft / Delta II Launch Vehicle Interface Requirements Document (IRD)

AUGUST 10, 2001

GODDARD SPACE FLIGHT CENTER
GREENBELT, MARYLAND

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NASA Goddard Space Flight Center
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CHANGE RECORD PAGE

DOCUMENT TITLE: GLAST Spacecraft / Delta II Launch Vehicle IRD

DOCUMENT DATE: August 10, 2001

ISSUE	DATE	PAGES AFFECTED	DESCRIPTION
Draft	08/10/01	All	

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1.0 Scope

This Gamma Ray Large Area Space Telescope (GLAST) Launch Vehicle Interface Requirements Document (IRD) is provided as a single source of baseline requirements placed on project subsystem engineers and KSC/Launch Service Provider (LSP) by the GLAST project. This includes all Spacecraft (SC)/Launch Vehicle (LV) interface requirements, and KSC facility and ELV Program Office requirements. This document is to be used for technical assessment and planning purposes only until this document is either formally superseded by the GLAST Launch Vehicle Interface Control Document (ICD) and/or a Launch Site Support Plan (LSSP).

1.1 Mission Information

The GLAST project is part of Space Science Enterprise under the theme of structure and evolution of the Universe. This multi-international partnership SC project shall be designed with a 5-year mission life with a goal of operating for 10 years. The GLAST observatory shall consist of two main science instruments and a SC bus providing power, propulsion, attitude control, communications, and command and data handling functions. The two main instruments are the Large Area Telescope (LAT) and the GLAST Burst Monitor (GBM). GLAST shall be a low-earth orbiting satellite, which shall measure the arrival time, energy and direction of gamma rays. GLAST will be in a low power mode during the ascent through separation from the launch vehicle. Once separated from the launch vehicle via ordinance signals from the launch vehicle, the GLAST spacecraft will begin its sun acquisition mode when sensing separation from the LV. The GLAST spacecraft will initiate orbit maneuvers after TBD seconds after release. Figure 1.1-1 shows a conceptual on-orbit configuration.

Figure 1.1-1 Example of a GLAST on-orbit configuration.

1.2 Launch Vehicle Description And Interface

The GLAST observatory shall be flown on an ELV Delta II-2920-10 as the primary payloads (PPL). The planned launch readiness date for GLAST is September 2006. Launch shall occur from the Cape Canaveral Air Force Station (CCAFS), Florida, launch site.

Figure 1.2-1 shows a typical Delta II 2920-10 (old Delta II nomenclature = 7920-10) launch vehicle configuration, which has been baselined for the GLAST mission. Additional information such as the fairing envelope of the 2920-10 vehicle is contained in Appendix A.

Figure 1.2-2 shows a standard LV 6915 Payload Attach Fitting (PAF) (TBR), which has been baselined for the GLAST mission. Additional information on the 6915 PAF is contained in Appendix B.

1.3 Observatory Description-Launch And Orbit Configuration

The GLAST observatory consists of a SC bus and science instruments as shown in Figure 1.1-1. The SC bus shall use the standard LV 6915 PAF (TBR) compatible with the 2920-10 LV. Figure 1.3-1 shows a typical launch profile/sequence of events for a LEO launch. Once operational, the GLAST SC shall provide the ability to collect and disseminate space environmental data.

Figure 1.2-1 Delta II 2920-10 Configuration

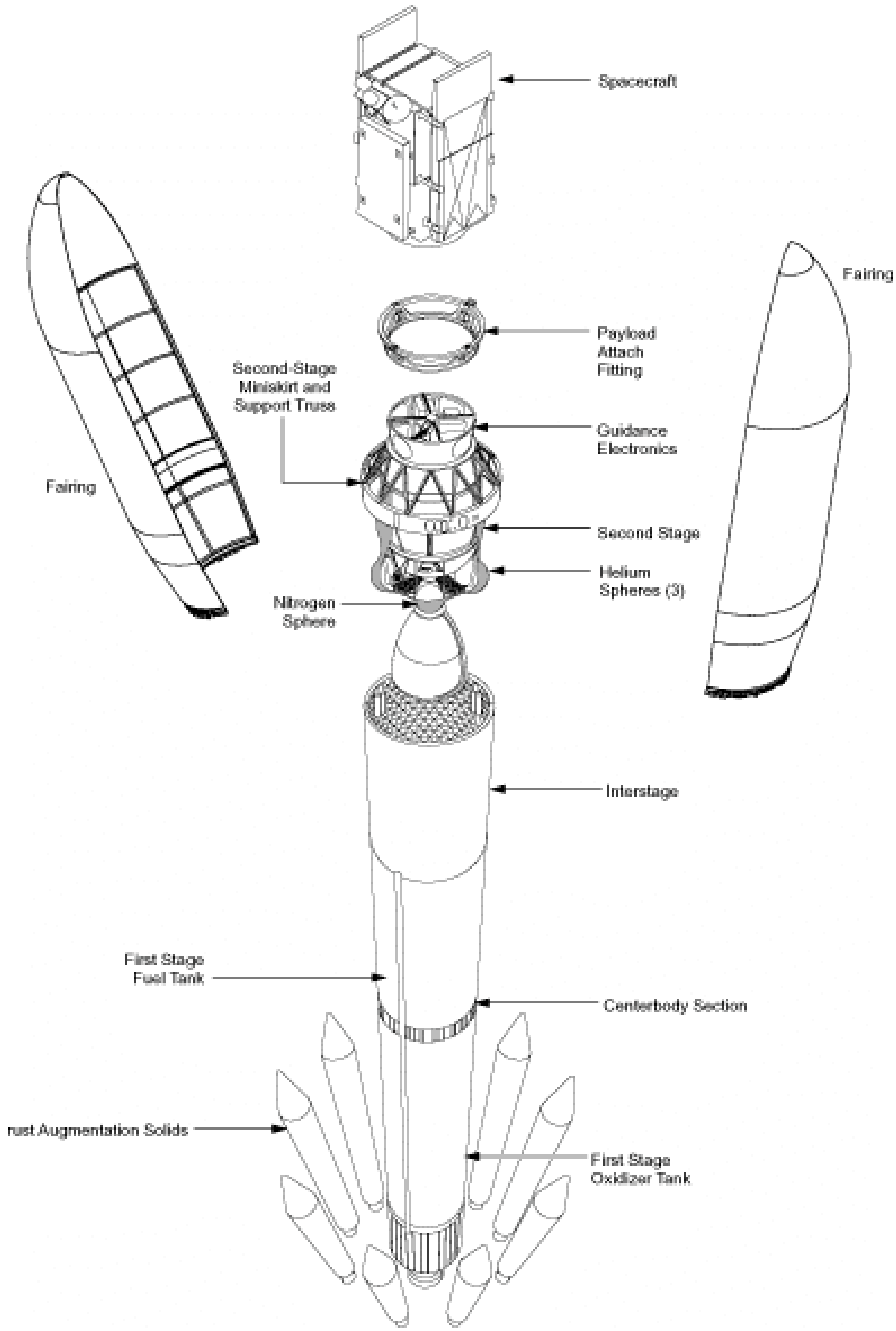


Figure 1.2-2- 6915 Payload Attach Fitting (PAF)

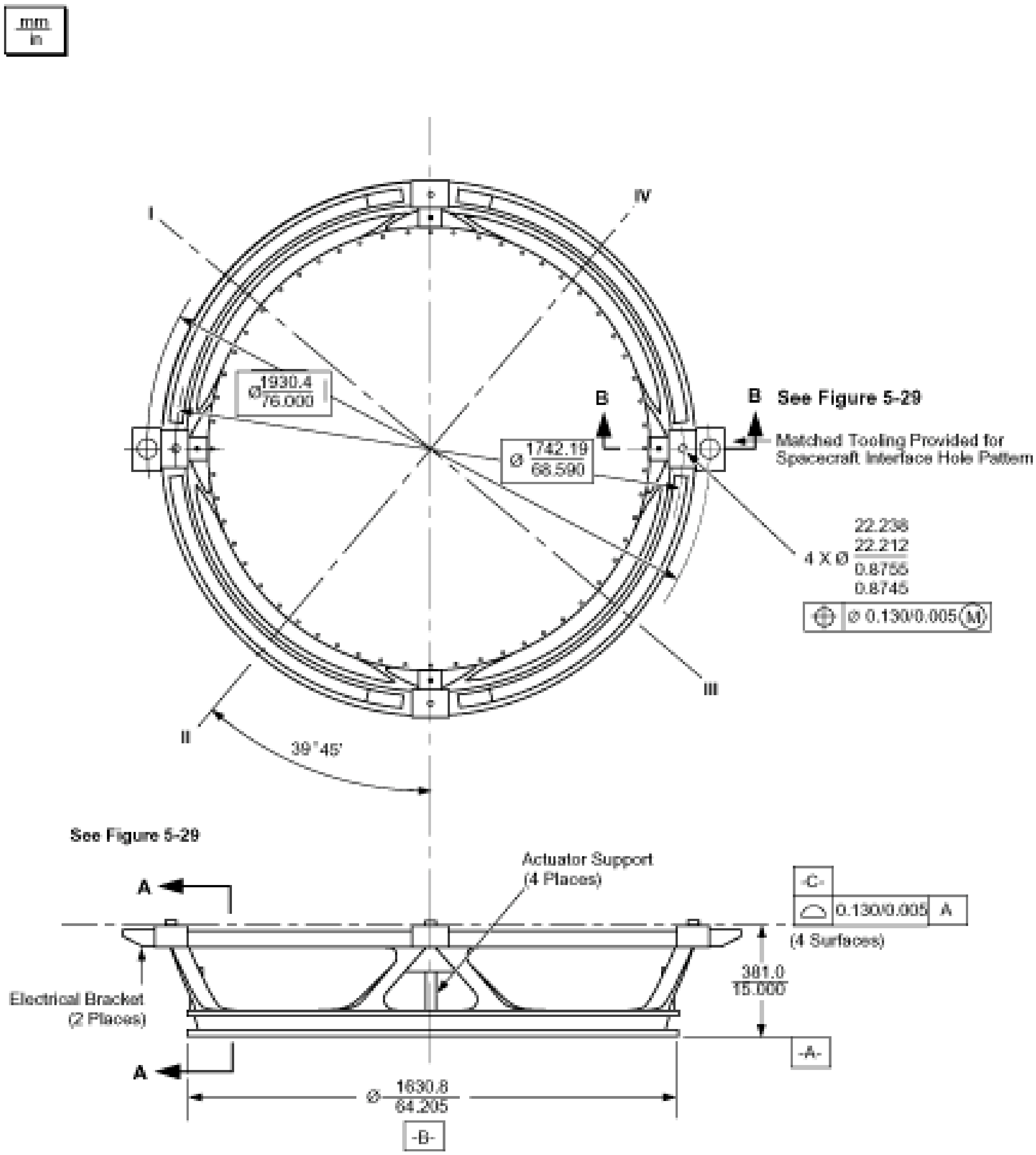
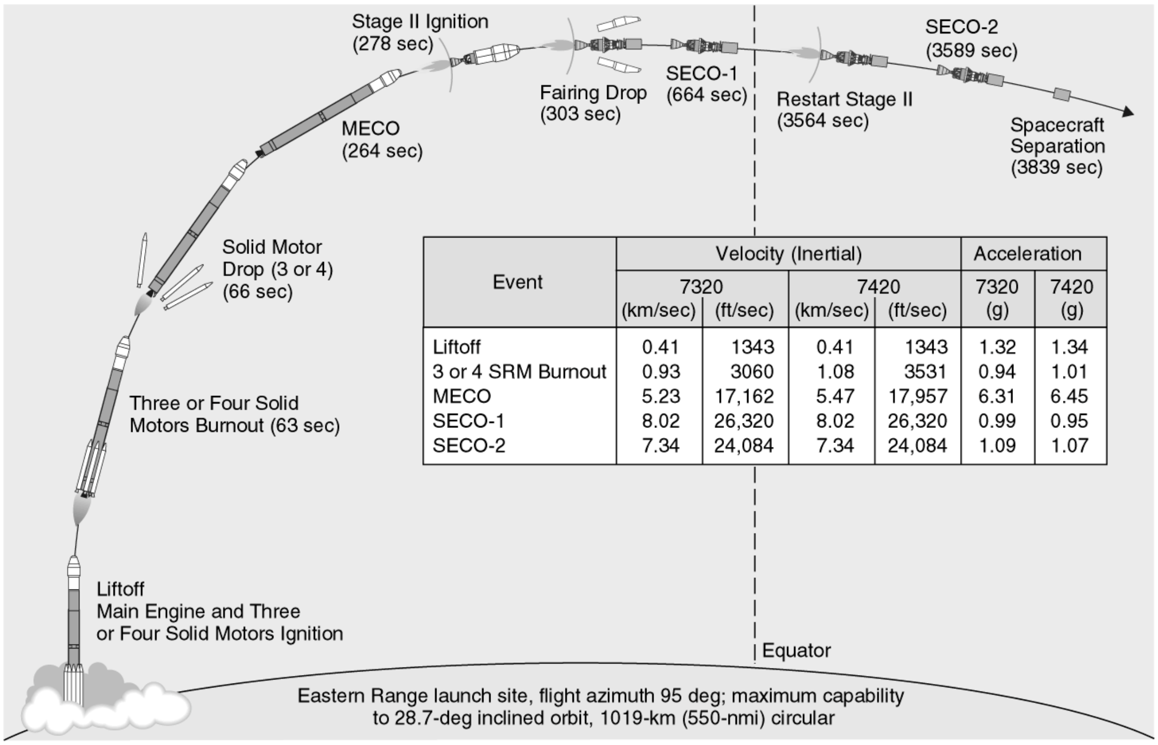


Figure 1.3-1 Typical flight profile for a LEO Mission (from liftoff to primary payload separation).



Event	Velocity (Inertial)				Acceleration	
	7320		7420		7320	7420
	(km/sec)	(ft/sec)	(km/sec)	(ft/sec)	(g)	(g)
Liftoff	0.41	1343	0.41	1343	1.32	1.34
3 or 4 SRM Burnout	0.93	3060	1.08	3531	0.94	1.01
MECO	5.23	17,162	5.47	17,957	6.31	6.45
SECO-1	8.02	26,320	8.02	26,320	0.99	0.95
SECO-2	7.34	24,084	7.34	24,084	1.09	1.07

1.4 Definitions

Hazardous Processing Facility (HPF):	Hazardous processing facility (HPF) at the launch site used for SC integration, propellant loading, pressurization, PAF mate and encapsulation.
Launch Pad (LP):	The LSP provided launch pad (LP) at the launch site for launch of the integrated SC/LV into the required orbit.
Launch Services Contractor (LSP):	The Launch Services Contractor (LSP) and its subcontractors responsible for provision of the launch vehicle (LV) and related launch services.
Launch Vehicle (LV):	The Delta II launch vehicle system provided by the LSP.
Payload Attach Fitting (PAF):	The structure provided by the LSP, which mates the SC to the LV and includes the separation system for SC/LV separation. The PAF is a part of the LV and does not separate with the SC.
Range:	The range shall be defined as the launch site area, the launch pad, and any facilities required to process and launch the SC.
Separation Plane:	The LV to SC mating plane at which SC separation occurs.
Spacecraft (SC):	The SC bus and all items supplied by S/C PO; GLAST satellite
Spacecraft Contractor (S/C PO):	Spacecraft Program Office/Contractor
Spacecraft Control Room:	A separate room located within or near the PPF/HPF. This room shall be used to accommodate all SC electrical ground support equipment (EGSE).

1.5 TBS/TBR Items
TBS

1.6 Abbreviations/Acronyms

AF	Air Force
AFRL	Air Force Research Lab
Boeing	Boeing Company
CBC	Common Booster Core
CCAM	Contamination and Collision Avoidance Maneuver
CCAS	Cape Canaveral Air Station
CCTV	Closed Circuit Television
CFRP	Carbon Fiber Reinforced Plastic
CLA	Coupled Loads Analysis
EED	Electro-Explosive Devices
EGSE	Electrical Ground Support Equipment
ELSA	Emergency Life Support Apparatus
ELV	Expendable Launch Vehicle
EMC	Electromagnetic Compatibility
EMI	Electromagnetic Interference
EMISM	Electromagnetic Interference Safety Margin
FMH	Free Molecular Heating
GBM	GLAST Burst Monitor
GHe	Gaseous Helium
GLAST	Gamma Ray Large Area Space Telescope
GN_2	Gaseous Nitrogen

GSE	Ground Support Equipment
GSFC	Goddard Space Flight Center
GO	Guest Observer
H_2O	Water (De-ionized)
HIRU	Hemispherical Inertial Reference Unit
HPF	Hazardous Processing Facility
HQ	Headquarters (NASA)
I&T	Integration and Control
ICD	Interface Control Document
I/F	Interface
IPA	Isopropyl Alcohol
IRD	Interface Requirements Document
IVT	Interface Verification Test
KSC	Kennedy Space Center
LAT	Large Area Telescope
LMA	Lockheed Martin Aeronautics Company
LP	Launch Pad
LRD	Launch Readiness Date
LSP	Launch Services Contractor
LV	Launch Vehicle
MMH	Monomethylhydrazine
MOU	Memorandum of Understanding
MPR	Main Power Rack
N_2O_4	Nitrogen Tetroxide
N/A	Not Applicable
NASA	National Aeronautics and Space Administration
nmi	Nautical Miles
NVR	Non-Volatile Residue

OSHA **P/L**	Occupational Safety and Health Administration Payload
PAF **PI**	Payload Attach Fitting Principle Investigator
PLF **PPL**	Payload Fairing Primary Payload
S/C PO **SC** **SC STE**	GSFC GLAST Project Spacecraft
SCAPE	Self Contained Atmospheric Protective Ensemble
SPL **SPO**	Secondary Payload Space Program Office
SPR **T-0**	Spacecraft Processing Room Time = Zero (Lift-off terminology)
TBD	To be determined
TBR	To be reviewed
TBS	To be supplied
TML	Total Mass Loss
UPS	Uninterruptible Power Supply
VCM	Volatile Condensable Material

1.7 NASA Launch Services (NLS) Standard Service List

Appendix C contains the list of NLS provided standard services provided to NASA customers for a Delta II two stage mission.

2.0 Applicable Documents (TBR)

The following documents form a part of this document to the extent specified herein.

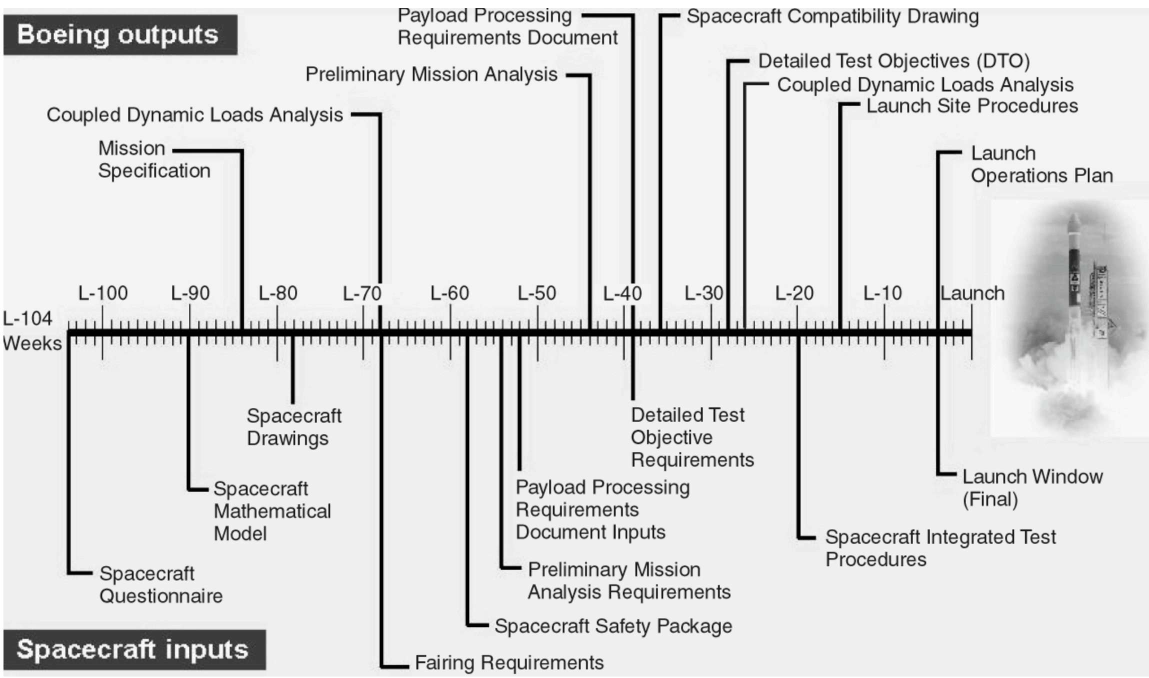
Document Number	Document Date	Document Title
ASTM D1193	Current Issue	De-Ionized Water
ASTM E-595	1993	Method for Total Mass Loss and Collected Volatile Condensable Material from Outgassing in a Vacuum Environment
DoD-W-83575A	22 December 1977	Wire Harness, Space Vehicle Design and Testing
EWR 127-1	31 October 1997, w/change pages dated 23 October 2000	Eastern and Western Range Safety Requirements
FED STD 209E		Airborne Particulate Cleanliness, Clean rooms and Clean Zones
	Current Issue	Delta II Payload Planners Guide
MIL-P-26539D, Amendment 1		Propellant, Nitrogen Tetroxide (MON-3, Low Iron)
MIL-P-27401C	20 January 1975	Propellant Pressurizing Agent, Nitrogen
MIL-P-27404B		Propellant, Monomethylhydrazine
MIL-P-27407A	28 November 1978	Propellant Pressurizing Agent, Helium
MIL-STD-1541A	30 December, 1987	Electromagnetic Compatibility Requirements for Space Systems
MIL-STD-1542B	15 April 1974	Electromagnetic Compatibility (EMC) and Grounding for Space System Facilities
MSIS-86	1 May 1987	Thermospheric Model, Journal of Geophysical Research, Vol. 92, No. A5, Pages 4649-4662
NASA-SP-R-0022A	4 September 1974	General Specification Vacuum Stability Requirements of Polymeric Material for Spacecraft Application
TOR-95(5663)-1	May 1995	Radio Frequency Environment, Eastern Range

TT-I-735	Current Issue	Isopropyl Alcohol
		GLAST Contamination Control Plan
		GLAST Propulsion Specification GLAST Mechanical Specification GLAST SC Specification

3.0 Mission Design Requirements

The LSP shall work closely with the GLAST project to implement the launch site requirements. Figure 3.0-1 shows a typical top level mission integration process flow. A Mission Integration Manager (MIM) shall be assigned at the beginning of the implementation phase to carry out the required interface requirements.

Figure 3.0-1 Typical Mission Integration Flow



3.1 Injected Mass Capability/LV Performance

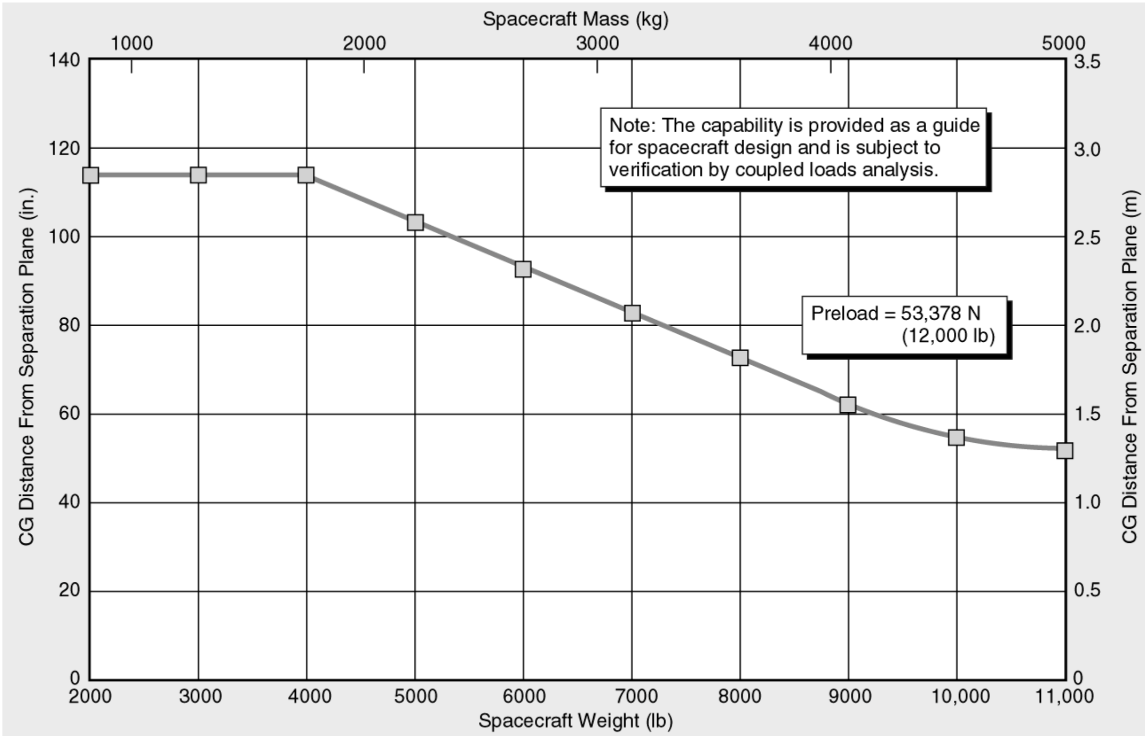
The LV launched from CCAFS shall be capable of placing GLAST separated mass into the equivalent energy transfer orbit on any day of the year. GLAST orbit is specified in Table 3.1-1 below. Altitudes are based on an earth radius of 6378 km (3444 nmi).

Table 3.1-1 LV Performance Capability for GLAST

Item	Value
SC Separated Mass	**< 4460 kg**
Nominal Transfer Orbit Apogee Altitude	**550 km**
Transfer Orbit Perigee:	**550 km**
Inclination:	**28 degrees**
Argument of perigee:	**TBD**

GLAST lift-off mass shall be within the capability of the 6915 PAF mass/c.g. limitations as shown in Figure 3.1-1.

Figure 3.1-1 Spacecraft Mass vs. c.g. Limits



3.2 Launch Period / Window Requirements

The LV shall be capable of supporting a continuous launch window of TBD. Launch window to be specified by the S/C PO by L-TBD days and shall include any mission constraints for eclipse, sun angle and ascending node.

3.3 Injection Targets

N/A

3.4 Final Orbit Insertion And Accuracy

The LV trajectory shall demonstrate the capability to inject GLAST to the final targets with a Figure of Merit (FOM) equal to or less than <TBD – 25> m/sec. The FOM shall be calculated assuming a trajectory correction maneuver <TBD> days after spacecraft separation from the second stage. Final orbit insertion and accuracy is shown in Table 3.4-1 below:

Table 3.4-1 GLAST Final Orbit Insertion and Accuracy

Parameter	**SC Requirement**
Apogee (km)	550
Perigee (km)	550
Inclination (deg)	28.5
ArgPer (deg)	TBD
LAN (deg)	TBD
RAAN (deg)	TBD

Eccentricity	<0.01 (TBR)

3.5 Park Orbit Requirements

Parking orbit requirements are shown in Table 3.5-1 below:

Table 3.5-1 GLAST Parking Orbit Requirements

Parameter	SC Requirement
Apogee (nmi)	TBD
Perigee (nmi)	TBD
Inclination (deg)	TBD
ArgPer (deg)	TBD
LAN (deg)	TBD
RAAN (deg)	TBD

3.6 Separation Sequence, Velocity

The LV shall generate commands for GLAST separation without re-contact within TBD seconds of LV final engine cut-off. The LV shall separate the GLAST from the LV with the conditions as shown in the Table 3.6-1 below. The GLAST separation system shall impart a minimum of TBD m/sec relative separation velocity between the GLAST S/C and the LV at separation. Tip-off rates shall not exceed TBD degrees/second in each axes.

Table 3.6-1 GLAST Separation Conditions

Attitude:	LV shall be capable of positioning the PPL in any attitude for separation. S/C PO shall define the SC target attitude by L-90 days.
Pointing Error:	Angle between the PPL centerline after separation and the desired GLAST attitude shall be □ 4.0 degrees (3 sigma value) (TBR).
Transverse Angular Rates: Tip-off Rates	TBD
Separation Velocity:	TBD m/sec
Spin Speed:	N/A rpm

3.7 LV Attitude Control Requirements

3.7.1 Spin Up Rates And System

N/A

3.7.2 Tip Off Rates, Coning

TBD

3.7.3 Nutation Time Constant

TBD

3.8 Contamination And Collision Avoidance Maneuvers (CCAM)
Contamination, collision avoidance maneuvers (CCAMs) shall be designed to preclude re-contact with GLAST. CCAMs shall minimize SC exposure to LV contaminants.

3.9 Special Trajectory Requirements: Sun Angle, Roll Attitude, Telemetry/Antenna Pointing
TBD

4.0 Interface Definition Requirements

This section shall identify the mechanical, electrical, and functional interfaces between the LV and the GLAST SC.

4.1 Mechanical Interfaces

4.1.1 Static Envelope

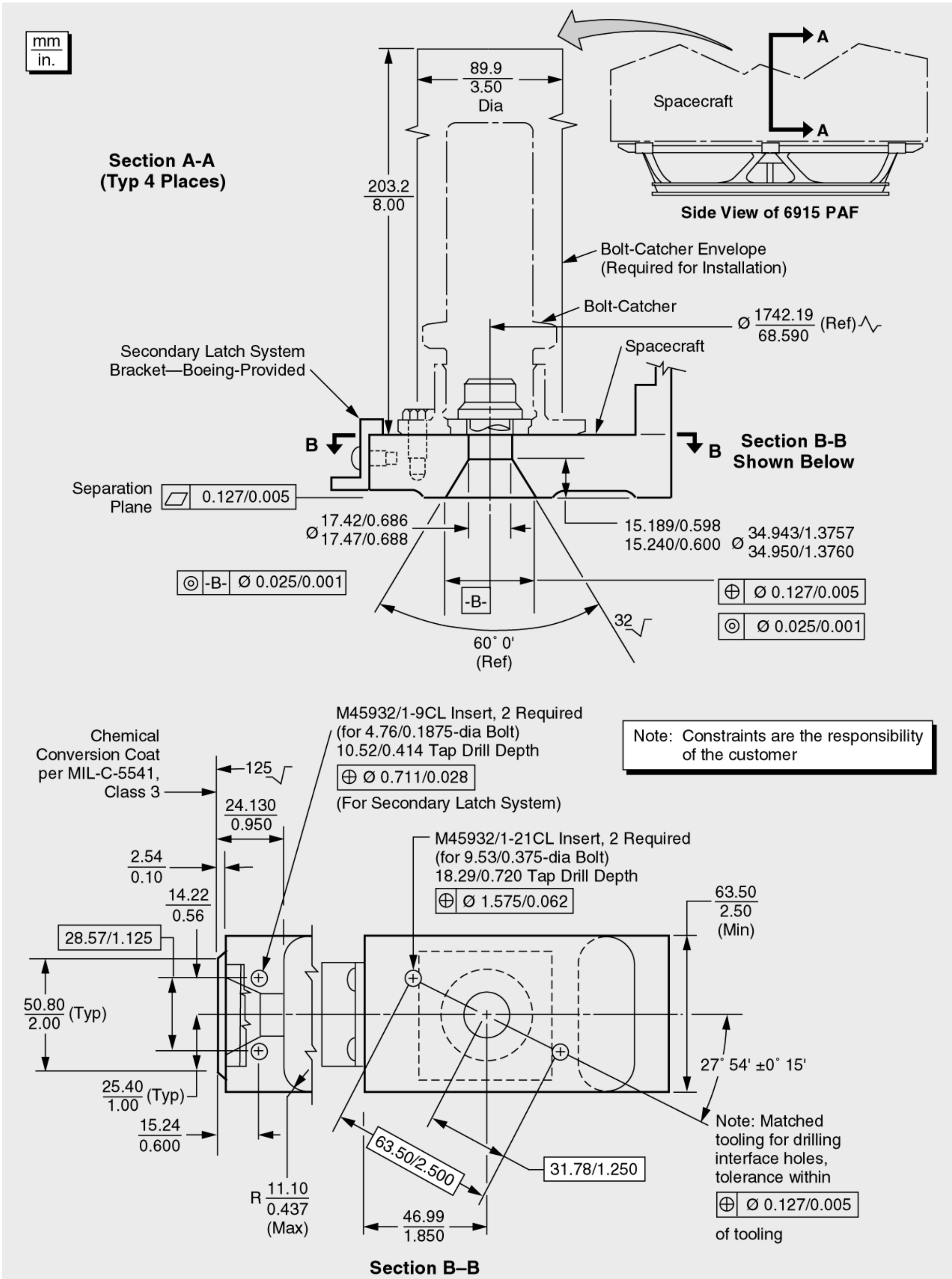
The LSP and its handling ground support equipment (GSE) shall accommodate the GLAST static envelopes defined in Appendix A (standard PPL static envelope). All GLAST components shall remain within these envelopes, including thermal blankets ballooning during ascent and tolerance stack-up (measured from the separation plane) under static, 1g conditions. Hardware-to-hardware clearances between the GLAST and the payload fairing (PLF) when subjected to the dynamic flight environment shall be determined through the coupled loads analysis and the clearance analysis. The GLAST design shall allow access for clampband installation as defined in the mission specific ICD.

4.1.2 Mechanical Attachment

The GLAST SC shall utilize the 6915 PAF to interface to the LV. The GLAST SC shall be mated to the PAF at the four equally spaced hard points with 15.9 mm (0.625 in.) preloaded bolts. A two step release system (TBR), consisting of four explosive nuts and a secondary latch, shall be employed to keep the tip-off rates at a minimum. Use of this system shall require a small lip (LSP provided) at each attach bolt location. The separation of the GLAST SC from the launch vehicle shall occur when the four explosive nuts are activated. The bolt and catcher assemblies shall remain with the GLAST SC upon separation.

The LSP shall provide the 6915 payload attach fitting (PAF), the two step release system and its associated hardware. GLAST shall conform to the SC interface dimensional constraints as shown in figure 4.1.2-1. Appendix B contains additional information on the 6915 PAF and release system.

Figure 4.1.2-1 SC Interface Dimensional Constraints



4.1.3 In-Flight Electrical

The LSP shall provide TBD electrical interface connector(s), part number TBD, for electrical power and signals to the GLAST S/C. In addition, the LV shall provide electrical connector/cabling for ordinance signals (1 primary and 1 redundant at a minimum) from the LV side of the interface to the clamp band ordinance electrical interface.

These connectors are located and oriented (connector keyways shall be oriented radically outboard) as shown in Appendix D (standard electrical interface). LSP/LV shall provide the mating pin connector halves, part number TBD for the GLAST side of the electrical interface. The connectors shall be adjustable in the GLAST S/C X and Y directions to provide for alignment of the connectors during mating. The LSP shall establish and control dimensional tolerances that will prevent the umbilical connector spring from becoming fully compressed resulting in excessive preload being transferred into the clamp band. The LSP/LV shall also establish dimensional tolerances to ensure proper mating of the connector halves is maintained from initial GLAST S/C to PAF mate and through all phases of ascent flight up to GLAST separation without the possibility of intermittent electrical contact.

4.1.4 Push-Off Pads

TBD

4.1.5 Separation System & Confirmation

The LSP shall provide verification of GLAST /LV separation via RIFCA parameters. GLAST SC detection of separation from the LV shall be required. The S/C PO shall use flight approved methods such as breakwires or mircro-switches (TBR) to determine the separation event from the LV. The connector/switch location shall be coordinated with the LSP. Typically, the separation plane (or within one inch of the separation plane) is the preferred mounting location.

4.1.6 Encapsulated GLAST Access

Up to three payload access doors are available to the S/C PO as a standard service. The door(s) shall be required to allow access the GLAST for final launch configuration closeouts. The LSP shall provide access to the GLAST S/C via standard 24 inch diameter access doors located at TBD station of the fairing.

4.1.7 Clocking

GLAST clocking for PAF mounting shall be recommended by the LSP to meet the requirements defined in this document. The final clocking shall be determined by mutual agreement of S/C PO & LSP and shall be documented in the mission specific ICD. Clocking of the payload access doors for GLAST shall also be determined by mutual agreement of S/C PO & LSP and shall be documented in the mission specific ICD

4.1.8 GLAST SC Coordinate System

The GLAST SC coordinate system is shown in Figure 4.1.8-1. The LV coordinate system and the GLAST coordinate can use the same coordinate system but is not required to be so.

Figure 4.1.8-1 GLAST Coordinate System

TBS

4.1.9 GLAST Purge Systems

GLAST SC shall require GN_2, grade B, (TBR) purging while processing the payload at the launch site and on the PAD.

4.1.10 RF Windows

TBD

4.2 Electrical Interfaces

4.2.1 RF Telemetry And Command Links

TBD

4.2.2 Hard Line Telemetry And Command Links

The hard line telemetry and command signals for supporting pre-launch and launch functions/tests shall be accomplished via T-0 umbilical. Table 4.2.2-1 shows the GLAST SC signals and pin assignments required to support launch preparations and launch.

4.2.3 Separation Loops

The GLAST shall require redundant separation indicator loops on the SC side of the interface to detect separation from the launch vehicle. If required by the LV side of the interface, the LSP shall provide a GLAST separation indicator(s). The indicator(s) can be implemented in the form of a breakwire set-up, magnetic switches, micro-switches, etc.

4.2.4 GLAST-To-Main Power Rack Wiring

The LV shall supply dedicated wiring from the SC Main Power Rack (MPR) interface, located in the blockhouse, to the SC/LV umbilical connector for SC bus remote power/return, bus voltage monitor, battery charging/return and battery temperature monitor. Bus power and battery charging functions shall be defined in Tables 4.2.2-1. GLAST shall be transferred to internal power approximately 5 minutes (TBR) prior to launch. The transition from external to internal power shall be verified by test prior to launch.

4.2.5 Grounding/Bonding

All shields in launch site facilities and any external wiring shall be grounded to prevent ground loops. The LSP shall perform a system grounding analysis to verify appropriate shielding and signal returns have been implemented to preclude ground loops for launch site facilities wiring.

4.2.6 Wire Harness Shielding

The LSP shall provide electromagnetic interference (EMI) control, in the form of wire twisting, shielding, and separation in accordance with DoD-W-83575A, or equivalent.

Table 4.2.2-1 GLAST Electrical T-O Umbilical Pin Assignments (TBR)

Pin No.	Signal Name	Input / Output	Signal Type (AC/DC)	Max Voltage (volts)	Characteristic Impedance of wire (Zo)	Max. LV Harness Capacitance (pF)	Max. 1-way Resistance (ohms)	Comments
	ELV Separation to C&DH							
	ELV Separation to C&DH -Rtn							
	ELV Separation to C&DH							
	ELV Separation to C&DH -Rtn							
	GLAST Separation From LV							
	GLAST Separation From LV-Rtn							
	GLAST Telemetry Signal							
	GLAST Telemetry Signal Rtn.							
	GLAST Command Signal 1							
	GLAST Cmd Signal 1 Rtn							
	GLAST Command Signal2							
	GLAST Cmd Signal 2 Rtn							
	Battery Disconnect							
	Battery Disconnect Return							
	EPS Power Enable #1							
	EPS Power Enable Return #1							
	EPS Power Enable #2							
	EPS Power Enable Return #2							
	DPC Power							
	DPC Power Return							
	GLAST Bat Trickle Charge Pwr							
	GLAST Bat Trickle Charge Power Rtn							
	Battery Voltage Telemetry							
	Battery Voltage Telemetry Return							
	Battery Temperature Telemetry							
	Battery Temperature Telemetry Return							
	Pyro 1 Status							
	Pyro 1 Status Rtn							
	Pyro 2 Status							
	Pyro 2 Status Rtn							
	Transponder H/L Override							
	Ground							
	Ground							

4.2.7 Ascent Telemetry

The LV shall have the capability of accepting one RS-422 type PCM serial digital data source with the characteristics shown in the umbilical pin assignment definitions. This data shall be provided to the SC STE while the LV is on the ground and through as much of the LV ascent as possible. The LSP shall provide the entire SC ascent TM from LV liftoff through LV/SC separation. The TM data shall be provided in tape format within 30 days from launch. Tape format shall be defined in the mission specific ICD.

4.2.8 Ordnance/Pyro/EEDs

Upon achieving the proper orbit altitude and position, the LV shall provide ordinance signals to ignite the pyrotechnics for the PAF explosive nuts. This event shall result in the release the GLAST in the proper direction and separation velocity. Details shall be defined in the mission specific ICD.

4.2.9 S/C To Blockhouse Wiring

The LSP shall be responsible for providing the wiring/cabling from the SC to the blockhouse. The S/C PO shall be responsible for providing the wiring/cabling from the blockhouse junction panel to the payload GSE designated area. Monitoring of this telemetry shall be made from the blockhouse after the GLAST SC is mated to the LV. Monitoring of the telemetry shall be accessible to just prior to liftoff. GLAST EGSE required to conduct GLAST SC checkouts while on the PAD, shall be housed in the Blockhouse. Wiring is provided from the Payload Console in the Blockhouse through the second stage LV umbilical connector, through the fairing wiring harnesses, and to the GLAST SC or PAF via a lanyard-operated quick disconnect connectors.

Baseline wiring between the Blockhouse and the fixed umbilical tower is the following:

- 60 Twisted Shielded Pairs (120 wires, No. 14 AWG)
- 12 Twisted Shielded Pairs (24 wires, No. 16 AWG)
- 14 Twisted Pairs (28 wires, No. 8 AWG)

A typical baseline wiring configuration is shown in Figure 4.2.9-1 where JU2 is the second stage umbilical connector and P1115/1118 are the second stage SC/PAF connector. The wiring service can provide up to 31 wires through each of the two fairing sectors. Additional wire accommodations may be available.

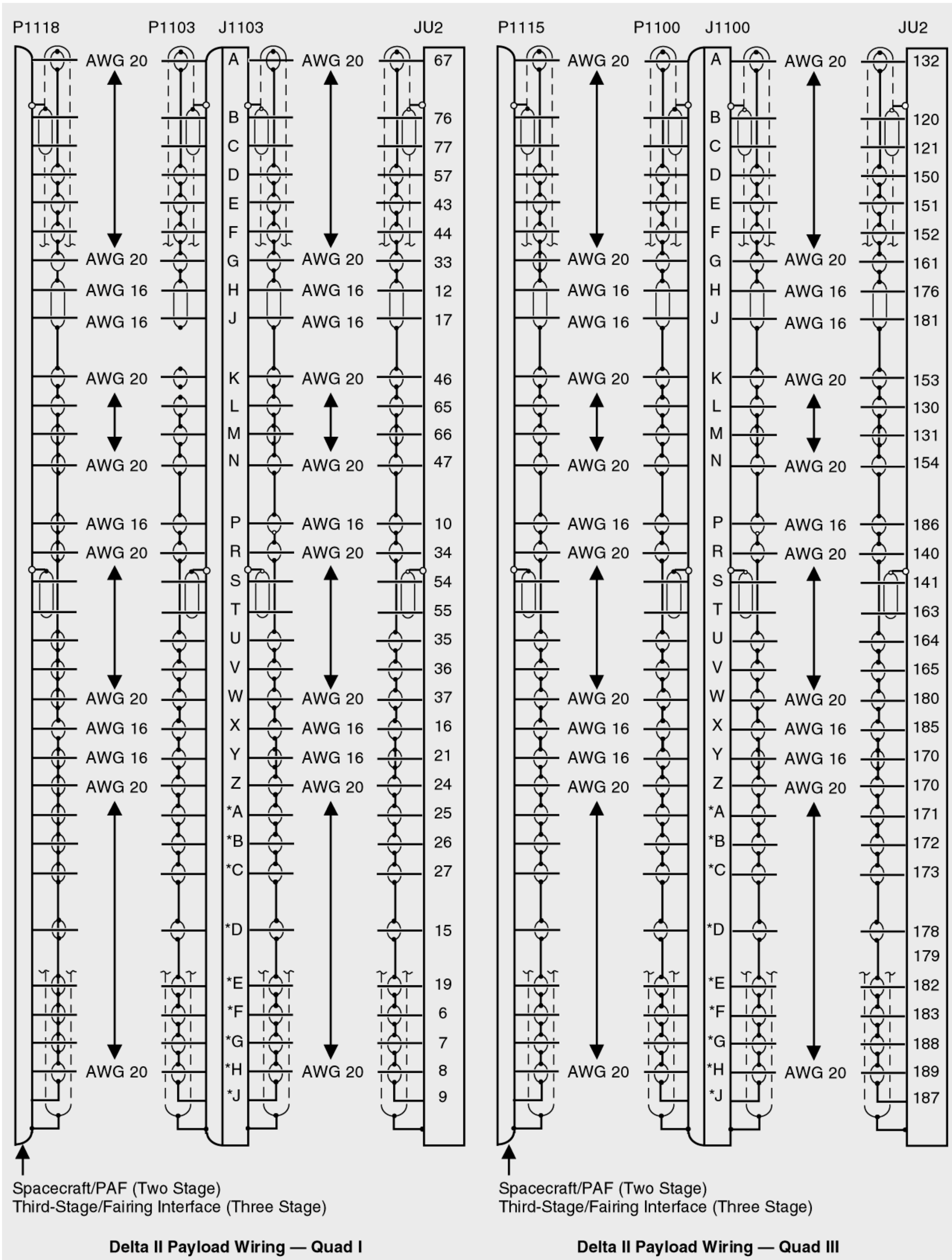
4.2.10 Deadfacing

All electrical circuits though the SC/LV shall be designed such that all necessary mating and de-mating of connectors can be accomplished without producing electrical arcs that might ignite surrounding materials or vapors. If possible, power shall be turned off prior to a mating/de-mating activity. If unavoidable, any disconnects of a powered connector shall be current limited to 100 mA or less across the interface.

4.2.11 Power Conditioning

TBD

Figure 4.2.9-1 Typical Delta II Wiring Configuration



4.3 Functional Interfaces

4.3.1 State Vector Telemetry

The LSP shall provide separation state vector data to the SC Mission Control Center within 45 minutes after the separation event (TBR). The telemetry data shall be taken from the LV prior to and as close as possible to the separation event for each S/C separation event. With the exception of launch time, the data shall be as of separation time. The telemetry data shall be as defined in Table 4.3.1-1 and shall be included in the mission specific ICD.

Table 4.3.1-1 State Vector Telemetry Data (TBR)

Parameter	Units
Launch time (GMT)	HMS
Separation time and confirmation (GMT)	HMS & sec from T-0
Semi-Major Axis	km (nmi)
Eccentricity	0.003
Inclination	27.5 deg
Right Ascension of the Ascending Node	deg
Argument of Perigee	deg
Mean or True Anomaly	deg
Perigee Height	450 km
Apogee Height	450 km
Separation Right Decension, deg J2000 ECI	deg
Separation Declination, deg J2000 ECI	deg
Separation Spin Rate	deg/sec

4.3.2 Post Separation Data

S/C PO shall provide SC-derived instantaneous orbital insertion and separation attitude data to the LSP within L+3 days (TBR). These data shall represent the most accurate orbit data available for an epoch propagated back to SC separation and prior to any SC impulsive maneuver. The data shall be as defined in Table 4.3.2-1. Details of the format of the post separation date shall be contained in the mission specific ICD.

Table 4.3.2-1 GLAST Supplied Separation Data (TBR)

Parameter	Units
Separation Date (GMT)	MDY
Separation Time (GMT)	HMS
Semi-Major Axis	km (nmi)
Eccentricity	---
Inclination	deg
Right Ascension of the Ascending Node	deg
Mean or True Anomaly	deg
Perigee Radius	km (nmi)
Apogee Radius	km (nmi)
Longitude of Ascending Node	deg
SC Separation Z-Axis Relative Right Ascension	deg
SC Separation Z-Axis Declination	deg

SC Separation Z-Axis Pointing Error	deg
SC Separation Spin Rate	rpm
SC Separation Tip-off Rate	deg/sec
SC Separation Nutation angle	deg

4.3.3 SC Mass Properties

The LV shall accommodate the SC mass properties defined in Table 4.3.3-1. Note: SC coordinate system is defined in Section 4.1.8.

Table 4.3.3-1. GLAST Mass Properties

Parameter	Nominal	Tolerance
SC Separated Mass	<4460 kg	+0%/-TBD
CG (S/C Coordinates): X	TBD cm	$\sqrt{X^2 + Y^2}$ □ TBD cm
Y	TBD cm	($\sqrt{X^2 + Y^2}$ □ TBD cm)
Z	TBD cm	± TBD cm
Moments of Inertia: I_{xx}	TBD kg-m^2	± 10%
I_{yy}	TBD kg-m^2	
I_{zz}	TBD kg-m^2	
Products of Inertia: I_{zx}	TBD kg-m^2	$\sqrt{I_{yz}^2 + I_{zx}^2}$ □ TBD kg-m^2
I_{yz}	-TBD kg-m^2	($\sqrt{I_{yz}^2 + I_{zx}^2}$ □ TBD)
I_{xy}	TBD kg-m^2	± TBD kg-m^2 (TBD)

4.3.4 SC Propellant Data

The LV shall accommodate the SC propellant properties, defined at the time of separation, shall be as defined in Table 4.3.4-1. The propulsion subsystem for GLAST consists of TBD.

The thruster plume cone angle shall be kept clear of any protrusions for a distance of 10cm (TBR). Note: SC coordinate system is defined in Section 4.1.8.

Table 4.3.4-1 GLAST Propellant Data

SC Tank	Mass Fill Fraction [1] max./min. (%)	Propellant Density @ 70 °F (lb./ft^3)	Tank Shape	Tank Interior Dims (in)	Damping Coeff. [2]	Tank (Fluid) Location X (in)	Tank (Fluid) Location Y (in)	Tank (Fluid) Location Z (in)
TBD			TBD					

[1] Fill fraction accounts for never to be exceeded max./min. tank loads in order to bound dynamic analyses. 100% fill fraction refers to a zero ullage condition. Fill fraction shall be between these levels.
Damping coefficient accounts for baffles and/or viscous effects.

5.0 Environmental Requirements

The LSP shall ensure that the SC is not exposed to environments exceeding those defined below from SC arrival at the launch site processing facility to separation from the LV.

5.1 Load Factors

5.1.1 Ground Handling, Transportation, Hoisting And Mating Loads

Ground handling, transportation, hoisting and mating loads shall not exceed quasi-static flight loads.

5.1.2 Quasi-Static Flight Loads

The LV shall not subject the SC to quasi-static flight loads at the SC C.G. greater than shown in Table 5.2-1 and Table 5.3-1. The SC primary hardware structural fundamental stiffness shall be greater than 10 Hz in the lateral mode and greater than 27 Hz in the axial mode. This shall apply to the SC hard-mounted at the separation plane.

5.1.3 SC Dynamic Model

The GLAST project shall provide a spacecraft dynamic mathematical model and associated transformation matrices to the LSP to support the coupled dynamic load cycle analysis per the following schedule:

Load Cycle	Schedule
1. Preliminary	Completed at PDR
2. Design	Complete Prior to structures subsystem CDA
3. Post-Test	After receipt of spacecraft modal test verified model (prior to L-6 months)

The LSP shall issue loads reports at the completion of each analysis and a final summary report at the completion of each loads cycle.

5.2 Sinusoidal Vibration

The maximum in-flight sinusoidal vibration levels measured at the PAF base shall not exceed those given in Table 5.2-1. The test levels may, with project concurrence, be notched so that spacecraft loads do not exceed flight limit loads for acceptance testing, and 1.25 times flight limit loads for protoflight testing. The protoflight sweep rate shall be 4 oct/min except in the frequency range of 25-35 Hz, where the sweep shall be 1.5 oct/min. For prototype testing, the sine vibration levels shall be the same as the protoflight levels and the sweep rates shall be reduced by a factor of two to 2 oct./min and 0.75 oct./min respectively.

Table 5.2-1 Sine Vibration Levels

Axis	Frequency (Hz)	Maximum Flight Level
Lateral	5 to 6.2 6.2 to 50	1.27 cm double amplitude 1.0 g (zero to peak)
Thrust	5 to 50	0.7 g (zero to peak)

1. Accelerations apply at the base of the payload attach fittings during testing. Response at fundamental frequencies should be limited based on vehicle coupled loads analysis.

5.3 Acoustics

The LV internal acoustic levels shall not exceed those listed in Table 5.3-1 from liftoff through payload fairing (PLF) separation. The flight levels shown are for a nominal fairing fill factor of 60% and with a 3 inch blankets in the fairing nose and the payload bay. Qualification and protoflight levels shall be 3 dB above those identified in the table below.

Table 5.3-1 2920 LV Max. Acoustic Levels,

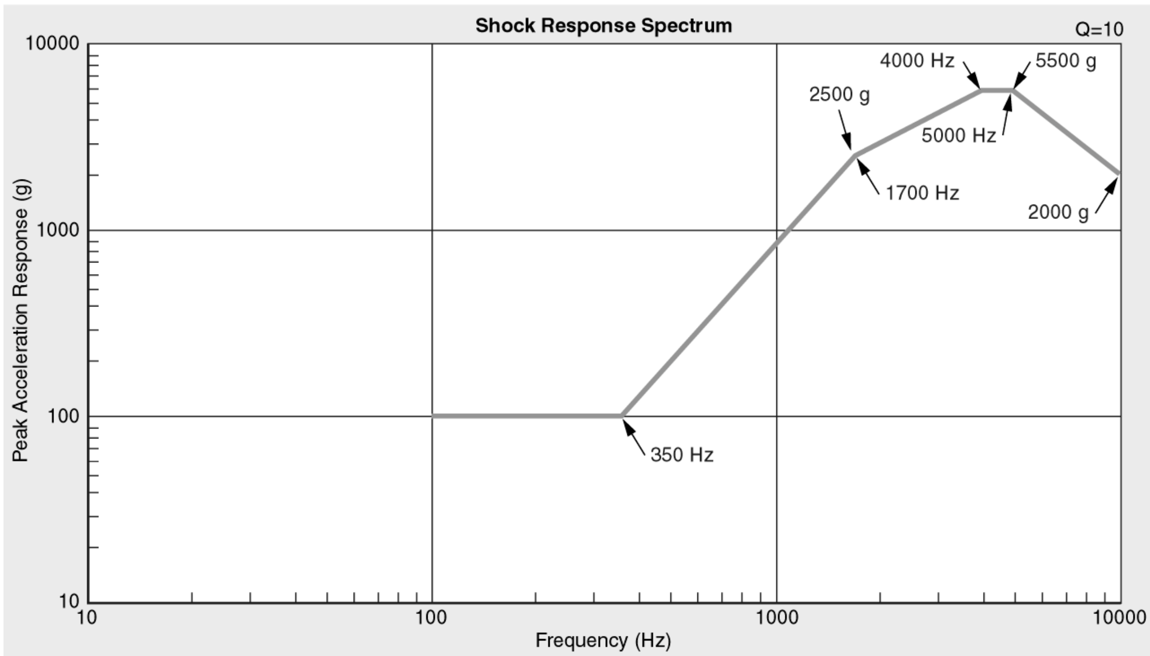
1/3 Octave Center Frequency (Hz)	Acoustic Environment (dB ref. 2.9E-09 psi)
31	119.5
40	122.5
50	126.5
63	128.0
80	130.0
100	130.0
125	130.0
160	130.5
200	131.5
250	132.5
315	131.5
400	128.0
500	125.0
630	122.0
800	120.0
1000	118.0
1250	117.0
1600	116.5
2000	116.0
2500	115.0
3150	113.5
4000	111.0
5000	107.0
6300	103.0
8000	100.0
10000	98.0
OASPL	140.6

1. Duration = 5 seconds (?).
2. With acoustic blanket.

5.4 LV/SC Generated Shock

The Delta II maximum shock at the separation plane interface shall not exceed the levels shown in Figure 5.4-1. The values shown were determined as the Maximum Predicted Environment (MPE) of MIL-STD-1540 (P95/50 statistics).

Figure 5.4-1 Maximum Acceptable LV Generated Shock Levels (For PAF 6915) (TBR)



5.5 Thermal And Humidity

Temperature limits during launch site processing is summarized in Table 5.5-1. Humidity requirements are addressed later in this section.

5.5.1 Preflight Requirements

The preflight phase is during all GLAST processing until the point of launch. During all phases of pre-launch processing, the each GLAST S/C shall be maintained in an environment with air/gas temperatures and relative humidity at the SC as defined in the following sections.

Table 5.5-1 Temperature Requirements (TBR)

Function	Limits	Applicable	Exceptions
Transportation And Hoisting	18°C to 24°C at all times; <5°C change/hour	Yes	TBD
Prior To Propellant Loading	18°C to 24°C	Yes	TBD

During Propellant Loading	TBD; to be achieved 24 hours prior to propellant loading operations	Yes	TBD
After Propellant Loading	18°C to 24°C	Yes	TBD
SC LP Temperature	18°C to 24°C at all times; <5°C change/hour	Yes	Radially and axially in the vicinity of the SC batteries shall have a control range, selectable by S/C PO, except during periods of high rate battery charging
High Rate Battery Charging	10°C to 18°C (TBR)	Yes	From the start of high rate battery charging, during a 12 hour period of ± 6 hours, the SC temperature shall be selectable by S/C PO at the air-conditioning inlet to achieve temperatures radially and axially in the vicinity of the SC batteries.
Temperature Through The Launch Window	18°C to 24°C ; <5°C change/hour	Yes	After air-conditioning disconnect until launch or through remainder of launch window radially and axially in the vicinity of the SC batteries, selectable by S/C PO.
SC Main Control Room And SC Subcontrol Room	22°C ± 3°C (71.6°F ± 5.4°F)	Yes	
Propellent Storage Room	10°C to 32°C (50°F to 89.6°F).	Yes	TBD
SC propellant conditioning in the storage room	21°C ± 1.1°C (69.8°F ± 2°F) and identical to the temperature of SC processing room (SPR) ± 1.5°C (2.7°F).	Yes	At least five (5) days prior to SC propellant loading,

5.5.1.1 Inlet Air Or Gas Flowrate

Inlet air/gas flow rate shall be selectable by S/C PO between 36.4 and 72.7 kg/min ±8 kg/min (80 and 160 lb/min ±16.6 lb/min) provided that the inlet gas temperature is independently controlled; if the inlet gas temperature is controlled by the flow rate, then the inlet gas flow rate shall be controlled ±3 kg/min (±6.6 lb/min)

5.5.1.2 Relative Humidity

5.5.1.2.1 Personnel Present

Relative humidity during all ground phases when personnel are working at or around SC shall be 30 to 50% relative humidity (air only) with all temperature sensors on or near the spacecraft reading greater than or equal to 5°C (9°F) higher than the dew point temperature of the air surrounding the spacecraft.

5.5.1.2.2 No Personnel Present

Relative humidity during all ground phases when no personnel are present at or around SC shall be 30 to 50% relative humidity (air or GN_2) with all temperature sensors on or near the spacecraft reading greater than or equal to 5°C (9°F) higher than the dew point temperature of the air surrounding the spacecraft. Relative humidity from 1 hour prior to liftoff shall be TBD% relative humidity (air or GN_2).

5.5.1.3 SC Power Dissipation

Maximum power dissipation for GLAST while encapsulated in the PLF while at the LP shall not exceed 400 W.

5.5.1.4 Temperature And Relative Humidity Monitoring Requirements

Temperatures in the vicinity of the S/C batteries and relative humidity as detailed in the above sections shall be continuously recorded and periodically monitored (with limit alarms) by the LSP during all phases. Any anomalies shall be reported to the S/C PO as soon as possible. Monitoring equipment shall be kept in calibration per appropriate specifications.

5.5.1.5 SC Main Control Room And SC Subcontrol Room Humidity

The non-condensable humidity shall be between 30 % and 80 %.

5.5.1.6 EGSE Heat Dissipation

The EGSE heat dissipation in the SC main control room and SC sub-control room shall be less than or equal to 8000 W each.

5.5.2 Flight Requirements

This section applies for the thermal requirements during launch through SC/LV separation.

5.5.2.1 Payload Fairing Surface Finishes And Temperatures

The requirements of this section shall be met by satisfying either the thermal flux and emissivity requirement or the temperature and emissivity requirement, or by integrated thermal analysis showing that temperatures of critical SC components are not exceeded.

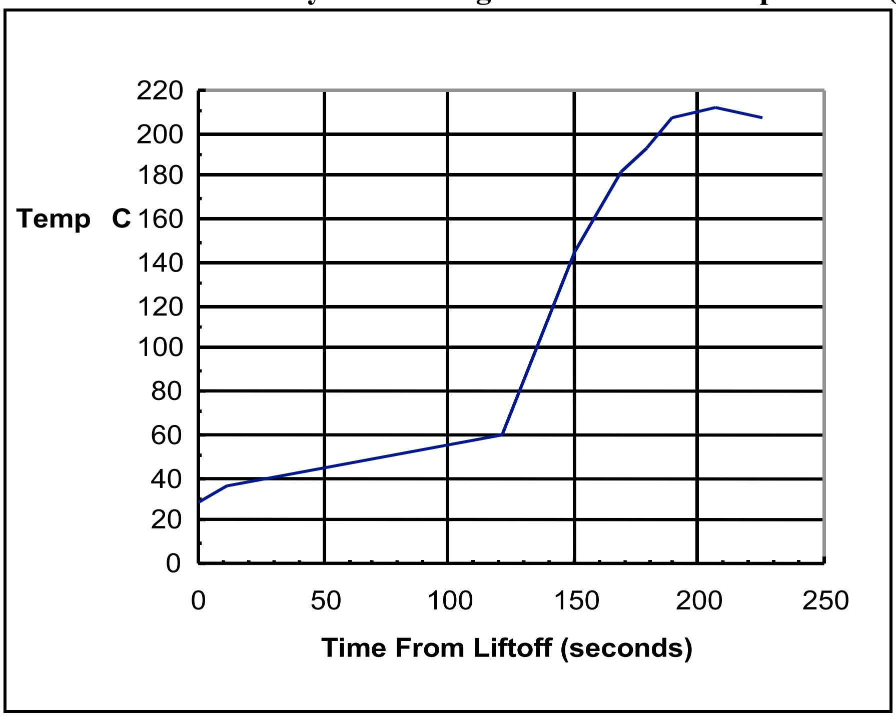
5.5.2.2 Fairing Inner Surface Temperature

Maximum temperatures of the inner surface of the LV PLF shall not exceed those shown in the Table 5.5.2.2-1 and Figure 5.5.2.2-1 below.

Table 5.5.2.2-1: Maximum payload fairing inner surface temperature (TBR)

Time From Liftoff	Temperature
0 sec	28.0 °C (82.4 °F)
11.000 sec	36.0 °C (96.8 °F)
121.00 sec	59.0 °C (138.0 °F)
151.00 sec	144 °C (291 °F)
169.00 sec	182 °C (360 °F)
179.00 sec	194 °C (381 °F)
189.00 sec	208 °C (406 °F)
206.00 sec	212 °C (414 °F)
226.00 sec	208 °C (406 °F)

Figure 5.5.2.2-1 Maximum Payload Fairing Inner Surface Temperature (Typical)



5.5.2.3 Maximum Heat Flux

Maximum heat flux to the SC from the PLF from time of launch through payload fairing jettison shall be 500 W/m^2 or less.

5.5.2.4 Payload Fairing Interior Thermal Emittances

Hemispherical thermal emittances of interior PLF surfaces that are not covered with an acoustical blanket shall be □ 0.10.

5.5.2.5 Instantaneous Free Molecular Heating

Maximum instantaneous 3-sigma dispersed free molecular heating (FMH) rate on the SC surfaces perpendicular to the velocity vector at the time of PLF jettison (based on atmospheric density versus altitude data from the MSIS-86 Thermospheric Model) shall be 1135 W/m^2 or less.

5.5.2.6 Instantaneous FMH After PLF Jettison

Maximum instantaneous 3-sigma dispersed FMH rate on the SC surfaces perpendicular to the velocity vector from the time of PLF jettison plus ten (10) seconds until SC separation shall be 690 W/m^2 or less.

5.5.2.7 Integrated Absorbed Dispersed FMH

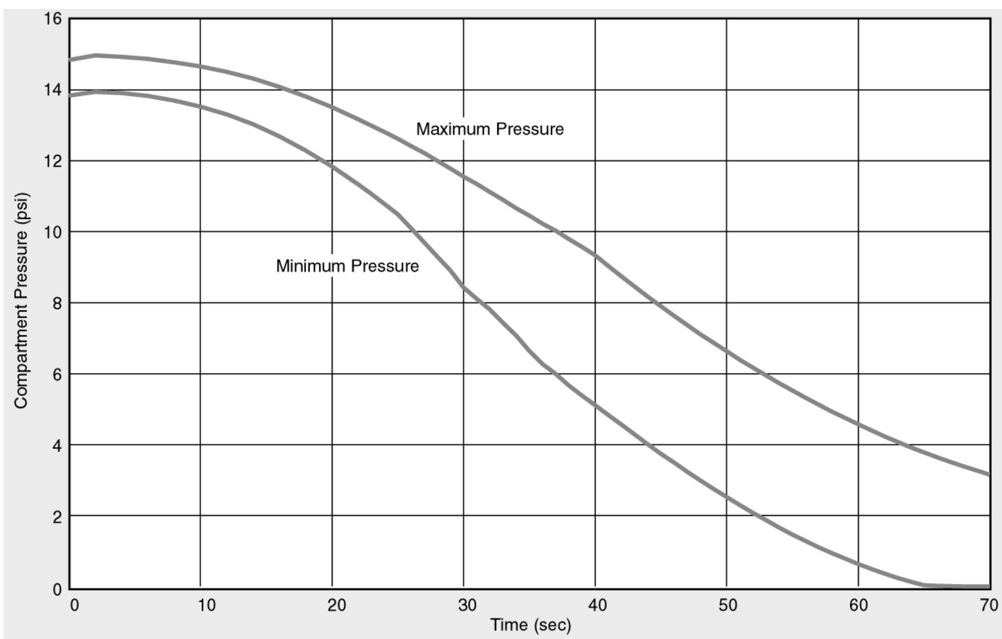
Maximum integrated absorbed dispersed FMH (defined as the integral of the heat over time, from time of PLF jettison to time of SC separation) shall be 212 W-hr/m^2 or less.

5.6 Pressure

5.6.1 Venting Requirements

The fairing is vented through an opening in the interstage and other leak paths in the vehicle. LV venting design and operation shall account for venting of SC internal volume through the payload adapter (PAF). The maximum pressure rate of change shall not exceed 0.5 psi/sec during ascent. The ascent pressure shall not exceed the profile shown in Figure 5.6.1-1. The spacecraft contractor shall perform a venting analysis to verify the venting profile is compatible with the GLAST design.

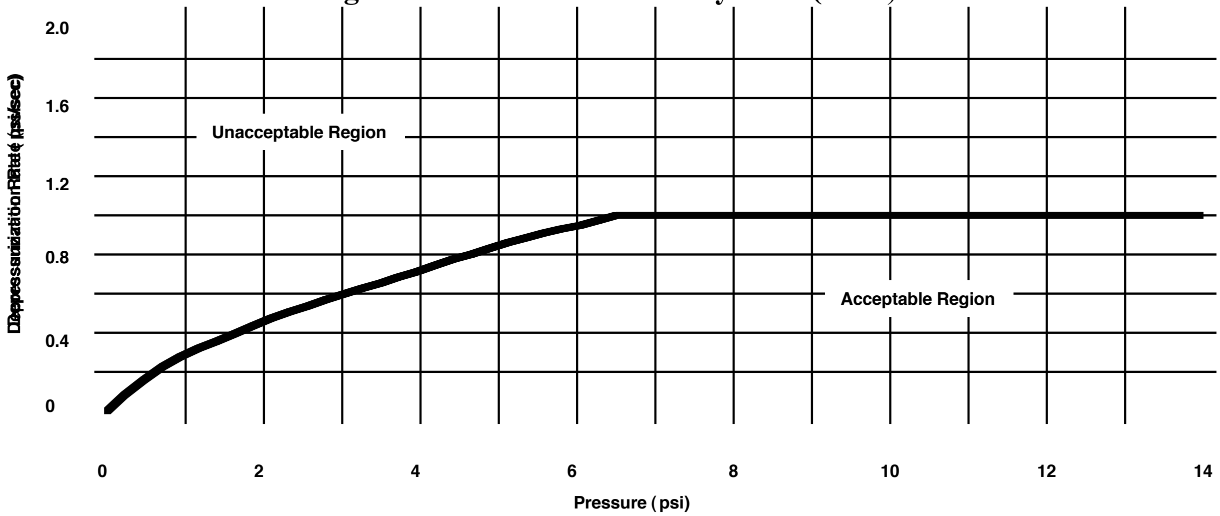
Figure 5.6.1-1 Ascent Pressure Profile



5.6.2 Pressure Decay Rate

The pressure decay rate inside the PLF/PAF during LV ascent shall not exceed the values given in Figure 5.6.2-1 and the pressure inside the PLF at PLF jettison shall be less than 0.015 lb./in^2.

Figure 5.6.2-1 Pressure Decay Rate (TBR)



5.6.3 Dynamic Pressure

Dynamic pressure from PLF jettison to SC separation shall not exceed 4.79 Pa (0.1 lb./ft2).

5.6.4 Air Impingement

Air impingement on SC surfaces during encapsulation and pre-launch operations shall not exceed 3 m/s (9.8 ft/sec).

5.7 Contamination

The LV and support equipment shall be designed so as to limit the contamination onto GLAST during integrated ground operations, launch and flight. LV and GSE hardware that come into contact with GLAST environment shall be processed to visibly clean standards (visibly clean as viewed from 6-18 inches under 100-200 candle-power white light) using accepted industry practices including isopropyl alcohol solvent wipes to achieve a specific level of cleanliness in order to limit cross-contamination onto GLAST. The procedures, practices and controls required to limit contamination onto GLAST shall be described in the LSP Contamination Control Plan.

5.7.1 LV Design

Materials used in the construction of LV hardware that comes into direct contact with the GLAST environment shall be controlled per the LV Contamination Control Plan.

To limit the volatile condensable material (VCM) content of the non-metallic materials contained in the LV electronic boxes, cable harnesses, paints, acoustic blankets, and carbon fiber reinforced plastics (CFRPs) mounted inside the PLF enclosure, the following upper limits are assigned to the values of the Vacuum Stability Parameters (%TML, %WVR, and %CVCM, as defined in ASTM E-595-93) of these non-metallic materials. The value of [%TML minus %WVR] shall not exceed 1.0%, however if a measurement of %WVR is not available, then the %TML alone shall not exceed 1.0%. The value of %CVCM shall not exceed 0.1%.

Alternatively, the "Total VCM Content" of all of the non-metallic materials contained in the LV electronic boxes, cable harnesses, acoustic blankets, CFRPs and paints mounted within the PLF enclosure shall not exceed 500 grams. The Total VCM Content is calculated as follows:

1. Obtain the weights, in pounds, of all electronic boxes, cable harnesses, acoustic blankets, and exposed CFRP structures within the LV PLF.

2. Multiply each of these weights by 0.32, 0.18, 0.24, and 1.53 respectively to obtain the Component VCM Content, in grams, of each component.

3. Obtain the total area, in square feet, of surfaces inside the PLF which are painted.

4. Multiply this area by 0.15 to obtain the Component VCM Content, in grams, in the paints.

5. Add the 5 Component VCM Contents, in grams, to obtain the Total VCM Content.

LV spin up or retrorockets and thrusters shall be oriented or canted to direct exhaust plumes away from GLAST surfaces. The LSP shall verify that the exhaust plume does not impact any GLAST surfaces. If the exhaust plumes do impact GLAST, the LSP shall perform, and provide to S/C PO, a RAMP II fully coupled flow field analysis that identifies the characteristics of the impinging flow field.

If S/C PO determines, from the results of this analysis, that the exhaust plume impingement is detrimental to GLAST, the LSP shall modify the design of the LV retrorockets/thrusters to preclude detrimental exhaust plume impingement on the affective structure.

Particles and gases from such items as PLF ascent venting, PLF separation pyrotechnics, and SC/LV separation pyrotechnics shall be shielded, directed, or sealed so as to contain contaminants and/or direct them away from GLAST.

5.7.2 Processing Cleanliness/Contamination Control

The cleanliness of launch vehicle hardware and associated GSE that comes into contact with the GLAST environment shall be controlled in accordance with the GLAST Contamination Control Plan. The GLAST science instruments shall have constant GN_2 (grade B) purge during all phases of launch site processing. All interior surfaces of the LV PLF shall be cleaned using procedures that have been previously verified under similar conditions to meet the following cleanliness criteria:

1. 0.3% maximum particulate obscuration

2. 10.8 mg/m2 maximum non-volatile residue (NVR)

3. S/C PO using tape lifts and solvent wipes shall verify the cleanliness of LV hardware, which will be in proximity to the SC. Results of the tape lifts and solvent wipes shall be used for engineering evaluation

4. GLAST shall be encapsulated and maintained thereafter in an environmentally controlled HEPA-filtered environment.

5. Air cleanliness in the HPF SC processing room (SPR) shall be Class 100,000 maximum as defined by FED-STD-209E, or equivalent. During SC payload instrument testing air cleanliness in the SPR shall be Class 10,000 maximum as defined by FED-STD-209E, or equivalent.

6. Air cleanliness in the PPF PLF encapsulation facility shall be Class 100,000 maximum as defined by FED-STD-209E, or equivalent.

7. After encapsulation in the PLF, active gas purges used during transportation and launch preparation shall be HEPA filtered and shall have its cleanliness level, as defined by FED-STD-

209, or equivalent, continuously measured and recorded using an isokinetic probe located at the PLF environmental control system outlet as close to the fairing as practical. Purge gas shall be Class 5000, or better, with less than 15 ppm hydrocarbon (methane equivalent).

8. The LV shall provide 2 PAF mounted brackets to accommodate S/C PO provided witness plates and witness plate holders. Witness plates will be installed prior to SC encapsulation and removed for flight just prior to launch. The LSP shall provide access to the witness plates so that they can be inspected and replaced periodically.

During ground operations, all LV sources, objects, and/or articles shall be restrained from impinging on any SC surface with sufficient kinetic energy to cause damage. There shall be no low kinetic energy debris allowed from LV sources of sufficient size to cause shorting of electrical devices or entanglement of mechanisms. No magnetic objects or articles shall be allowed to impinge or settle on SC surfaces.

5.7.3 In-Flight Contamination

1. Following GLAST SC separation from the LV, the LSP/LV shall perform a contamination and collision avoidance maneuver (CCAM) to minimize GLAST SC contamination and avoid future contact with the GLAST SC. Minimized GLAST SC contamination, including the impingement of LV exhaust plumes, shall be considered in the CCAM design.

5.7.4 Helium and Other Contaminates

From payload encapsulation in the PLF to PLF separation the total payload exposure to contaminants such as helium shall not exceed a maximum of 1400 torr-hrs (TBR).

5.8 EMC/EMI/RF/Radiation Compatibility

LV design & LV operation at the Range shall use, as a guide, MIL-STD-1541A for existing LV/Range or MIL-STD-1542B for new LV/Range to ensure electromagnetic compatibility between the GLAST SC and LV/Range.

5.8.1 GLAST SC Radiated Emissions

GLAST SC radiated emissions from intentionally transmitted GLAST SC telemetry shall not exceed the values show in Table 5.8.1-1 below. Radiated power and antenna gain are given rather than electric field, as the electric field value will depend strongly on the relative location of the source and the field point.

Table 5.8.1-1 Maximum SC Radiated Emissions

SC Telemetry Transmit		
Frequency	**Maximum Radiated Power**	**Maximum Antenna Gain**
TBD	TBD	TBD

Note: In the frequency range between 30 MHz and 40 GHz where there are no intentional transmitters listed, the unintentional SC radiated emissions external to the SC shall not exceed 80 dBμV/m.

5.8.2 GLAST SC Susceptibility

From GLAST SC arrival at the Range until GLAST SC/LV separation, the GLAST SC shall not be exposed to any source of LV or Range radiated emissions exceeding the maximum acceptable GLAST SC environment. The LSP shall coordinate masking or attenuation of any radiated emission sources which result in electromagnetic interference safety margins (EMISMs) of no less than 6 dB for sensitive SC receivers shown in Figure 5.8.2-1 and 20 dB for SC ordnance shown in Figure 5.8.2-2. The LSP shall inform S/C PO of any changes to the LV & Range RF environments shown in Table 5.8.2-1.

Figure 5.8.2-1 SC Receivers Susceptibility (SAMPLE)

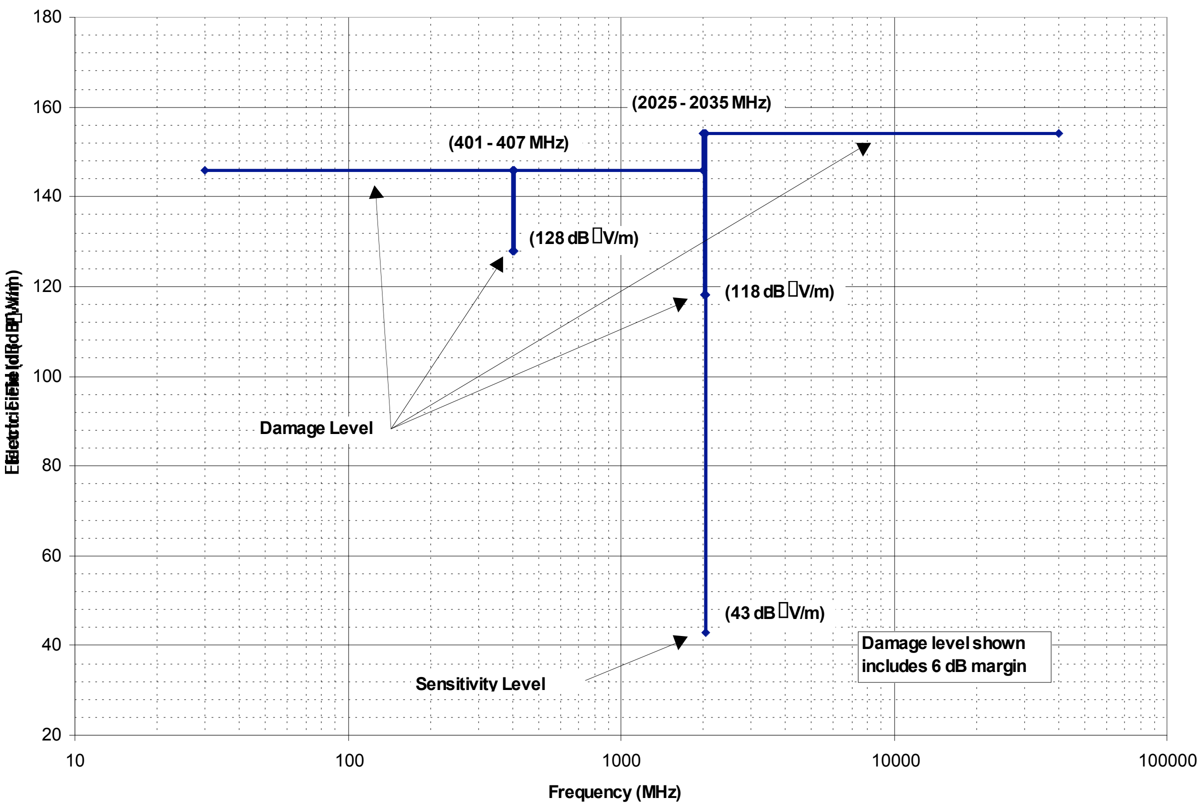


Figure 5.8.2-2 SC Ordnance Susceptibility (Continuous Wave) (SAMPLE)

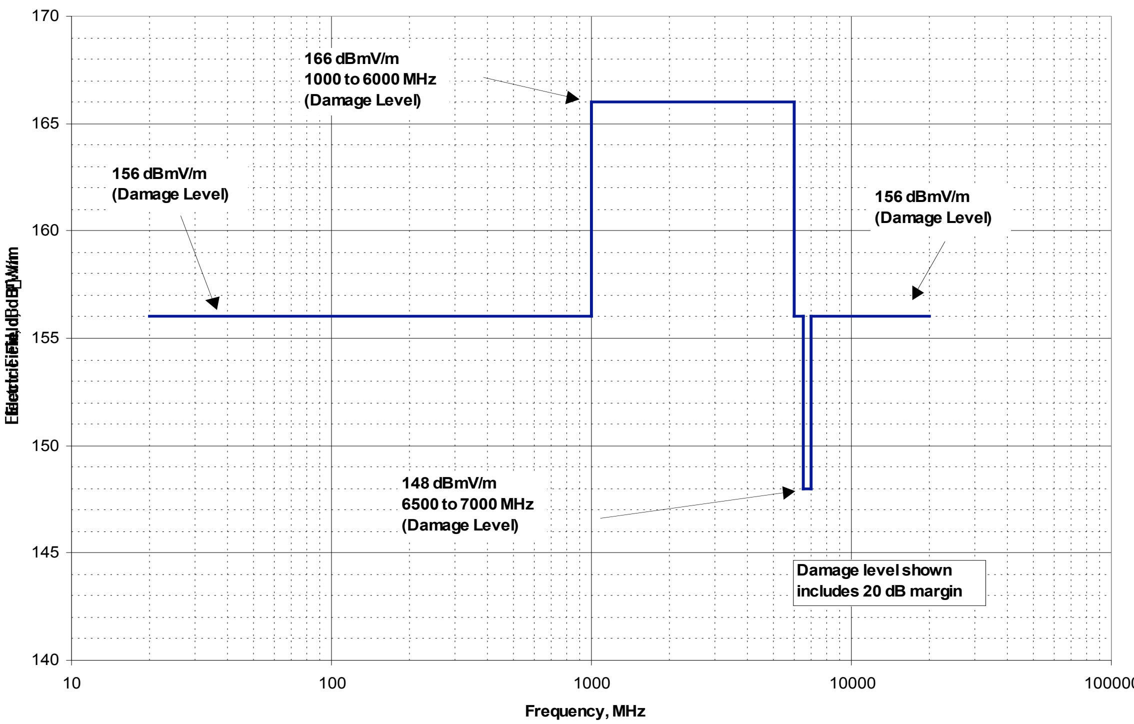


Table 5.8.2-1 LV & Range RF Environment

Receive			Transmit		
Receiver	**Frequency (MHz)**	**Sensitivity (V/m)**	**Transmitter**	**Frequency (MHz)**	**E Field (V/m)**
TBS	TBS	TBS	Radar 0.14	5690	111.1
			Radar 1.16	5690	169.5
			Radar 1.39	5690 & 5800	82
			Radar 19.14	5690	169.9
			Radar 19.17	5690	28.7
			Radar 28.14	5690	17.9
			Radar 1.8	9410	4.7
			Radar FPS-66	1265 & 1345	11.5
			Radar GPN-20	2750 & 2840	5.9
			WSR-74C	5625	15.8
			WSR-88D	2879	14.5
			GPS Grnd Sta	1784	6.5
			NASA STDN	2025 to 2120	5.8
			TVCF	1761 to 1842	5.4
			BPSK Telemetry	2211	35.5
			C-Band Tracking	5765	86.1

Note:

1. In the frequency range between 30 MHz and 40 GHz where there are no intentional transmitters listed, the unintentional LV radiated emissions shall not exceed 100 dBμV/m, and the unintentional Range radiated emissions shall not exceed 120 dBμV/m.
2. Based on RF environments defined in TOR-95(5663)-1.

5.8.3 LV/SC Interface Bonding Resistance

The resistance between the launch vehicle ground and the GLAST SC ground shall be less than 1 kohm.

5.8.4 Lightning Protection

Where possible, the spacecraft shall be provided with 20 Db of shielding from lightning generated, radiated electric fields. Measures shall also be taken to minimize the possibility of a direct lightning strike to the spacecraft.

5.8.5 Radioactive Devices

N/A (TBR)

6.0 Facilities And Services

KSC shall arrange for the facilities, equipment, supplies, storage, personnel and procedures to receive, transport, process, test and integrate the GLAST SC and associated support equipment with the LV, and launch the GLAST SC. A Payload Processing Facility (PPF), Hazardous Processing Facility (HPF), Launch Pad (LP), Blockhouse facility, office space and storage facilities for propellants, ordnance, support equipment and miscellaneous supplies shall be arranged for by KSC. Details of all processing requirements shall be provided at L-12 months.

6.1 SC Processing Facility

The PPF processing facility shall include as a minimum, clean room for GLAST SC processing (hazardous and non-hazardous), air lock room, storage for GSE, storage for electro-explosive devices (EEDs), office space and any additional rooms needed to support the requirements herein.

6.1.1 Air Lock Room

The air lock room is for receiving and processing the GLAST SC in the GLAST SC shipping container prior to processing in the SC processing room. This room shall be large enough to accommodate the GLAST SC in the shipping container, miscellaneous support equipment, and personnel. The air lock room shall be used to unload the GLAST SC container from the transport device and wipe down of the GLAST SC container before entering the SC processing room. A facility TBD ton crane shall be available to GLAST personnel to remove the GLAST SC from the shipping container and to move the SC to the SC processing room, if required. A TBD ton hydroset shall be provided by the SC PO for use in all moves requiring a facility crane. A facility air supply (TBD psi minimum) (TBR) and electrical power shall be available to the SC PO.

6.1.2 SC Processing Room (SPR)

The SPR shall be capable of accommodating the GLAST SC and GLAST SC processing equipment defined in Table 3.4.1.2-1 with a minimum floor space for GLAST SC equipment of 150m^2 (TBR), with one side a minimum length of 15m. Office space shall be provided adjacent to the SPR. The SPR shall have all required operational and personnel support equipment, all

OSHA and range safety required equipment (or equivalents), and sufficient floor space to accomplish standard SC processes such as hoisting of the GLAST SC onto the test stands/fixtures, GLAST SC to PAF mate check, GLAST SC checkout, and ordinance work. During these operations all applicable OSHA standards, or equivalent, shall apply. During all SC operations the following minimum environmental requirements shall apply:

1. Temperature as defined in Section 5.5.
2. Humidity as defined in Section 5.5.
3. Cleanliness as defined in Section 5.6 and 5.7.
4. Flame retardant anti static clean room garments, anti static footwear, cleaning services and change room shall be provided. During SC payload instrument testing, clean room garments shall also be compatible with Class 10,000 requirements.
5. A fixed closed circuit television (CCTV) shall be provided for remote viewing activities from the control rooms.
6. Compressed air for air-powered tools.
7. See Table 6.1.2-1: Example of Processing Area SC Equipment (Major Items).
8. Lightning warnings as defined in Section 6.10.7.

Table 6.1.2-1 Example of Processing Area SC Equipment (Major Items) (TBR)

ITEM	SIZE (m) L x W x H	WEIGH T (kg)	POWER REQ's	ADDITIONAL REQ.'S
SC shipping container (12-300 container)	11.8 x 4.2 x 4.2	TBD kg plus SC mass	N/A	Minimum crane height required
SC Rollover Fixture	4.9 x3.7 x 3.5	TBS	120/208 three phase 60A	
Fueling Stand	2.0 x 2.0 x 2.0	1000	N/A	
Genetrons	2.0 x 1.0 x 1.0	970 (empty)	N/A	5 day storage before fueling required
Propulsion GSE:				
- Weighing system	2.5 x 1.3 x 0.7	410	60 Hz/110v UPS with Explosion Proof Connections	
- Panel	1.1 x 0.8 x 1.6	132	N/A	
- Cart	1.0 x 1.3 x 1.6	443	60 Hz/110v UPS with Explosion Proof Connections	
- Panels (2)	0.7 x 0.5 x 0.6	172	N/A	
Misc. Boxes/Tool Sets	1.0 x 0.8 x 1.3	114	N/A	

6.1.3 Propellant Storage

The LSP shall provide for storage of propellants for subsequent use in the HPF. The temperature of the storage facility shall be maintained as defined in section 5.5. At a pre-determined time, the propellant shall be made available for the GLAST S/C propellant loading process.

6.1.4 Miscellaneous Storage

The KSC-ELV PO shall provide room for storage of other SC ground support equipment and EEDs. In the case of a launch delay, the KSC-ELV PO shall provide a clean room storage facility with the proper environmental controls and purging services if the GLAST SC cannot be returned to the PPF for temporary storage until the payload can be launched. In addition, KSC ELV PO shall be provide storage for the support equipment (MGSE, EGSE, etc.) if a launch delay occurs.

6.1.5 SC Hazardous Processing Facility (HPF)

The HPF facility shall be used for the assembly, test, ordinance work, propellant loading, and pressurization of the SC. The airlock shall be a class 300K area capable of handling the GLAST SC and its transportation canister. The clean work area shall be a class 100K clean room or better. Also contained in the HPF shall be the necessary equipment required to perform propellant loading and pressurization on the SC. Details for this facility shall be contained in the mission specific ICD.

During GLAST operations in the HPF, the following minimum environmental requirements shall apply:

1. Temperature as defined in Section 5.5.
2. Humidity as defined in Section 5.5.
3. Cleanliness as defined in Section 5.6 and 5.7.
4. Flame retardant anti static clean room garments, anti static footwear, cleaning services and change room shall be provided. During SC payload instrument testing, clean room garments shall also be compatible with Class 10,000 requirements.
5. A fixed closed circuit television (CCTV) shall be provided for remote viewing of hazardous activities from the control rooms.
6. Local monitors with remote alarms for MMH and N_2O_4 hazardous vapor detection.
7. Blast shield for SC pressurization.
8. Compressed air for air-powered tools.
9. Six (TBR) self contained atmospheric protective ensemble (SCAPE) suits for use during propellant handling and fueling operations.
10. Emergency life support apparatus (ELSAs), leg stats (or equivalent) and a ground tester.
11. See Table 6.1.2-1: Example of Processing Area SC Equipment (Major Items).
12. Lightning warnings as defined in Section 6.10.7.

6.1.6 SC Spin Table

TBD

6.1.7 SC Battery Storage Area

TBD

6.1.8 Alignment Equipment

TBD

6.2 SC Main Control Room

The SC main control room shall be located as close as practical to the SPR. This control room shall include access for electrical links to the SC processing area and visual access to the SPR via CCTV. The control room shall accommodate the EGSE and its requirements as defined in Table 6.2-1, spare EGSE and storage with a minimum floor space for SC equipment of 100 m^2 (TBR). Office space shall be provided adjacent to the control room per the requirements in section 6.5.

6.3 Vertical Processing Facility/Launch Pad

The LSP shall equip the LP with the following facilities and services for use by S/C PO.

6.3.1 LP SC Equipment Room (TBR)

The LSP shall provide an equipment room at the LP that accommodates the MPR, Power Conditioning Unit, Telemetry & Command Box and Mixing Box with a minimum floor space of 10 m^2(TBR) for this equipment.

6.4 SC RF Equipment Link Requirements (TBR)

The LSP shall provide all RF links during all phases of SC processing at the launch site as defined in section 5.8.

6.5 Office Space

The LSP shall provide air-conditioned industry standard office space with adequate equipment for launch operations. This equipment includes, but is not limited to, electrical power, telephones, faxes, copiers, work spaces, file cabinets, desks, chairs, etc. Office space shall be large enough to accommodate the GLAST launch team. The GLAST Launch Team shall be defined at L-6 months.

6.6 Transportation Services

The LSP shall provide support for transportation of GLAST (GLAST in SC shipping container to the PPF, to the HPF, and GLAST in handling can to the LP), GSE and EGSE from SC arrival at the airport and/or launch site through launch. The operational timeline shall be chosen such that SC transport from the HPF to the launch pad incurs the minimum risk of electrical storm activity. SC transportation operations shall not begin if lightning storms are occurring within 5 nautical miles of the spacecraft at any time during the transportation operation.

Table 6.2-1 Control Room Area Equipment (SAMPLE)

ITEM	QTY	SIZE (m) L x W x H	MASS (kg)	POWER REQ (maximum)
SC Control Room:				
GTACS Server Workstation	1	0.9 x 1.3 x TBS	TBS	
Bus Workstations	2	0.9 x 1.3 x TBS	TBS	
DAW	1	0.6 x 1.3 x TBS	TBS	
Console	1	1.2 x 1.1 x TBS	TBS	
RAS Terminal	1	0.5 x 0.7 x TBS	TBS	
RAS Server	1	0.6 x 1.0 x TBS	TBS	
SXI UPS	1	0.6 x 1.0 x TBS	TBS	
SXI Workstation 1&2	1	1.7 x 1.0 x TBS	TBS	
NTACTS [1]	1	1.3 x 0.6 x TBS	TBS	
MRS&S [1]	1	1.3 x 0.6 x TBS	TBS	
T&C/SD/MDL [1]	1	1.0 x 1.2 x TBS	TBS	
MPR [1]	1	1.0 x 1.3 x TBS	TBS	
Isolation Transformer [1]	1	1.4 x 0.6 x TBS	TBS	120/208 three phase 60A UPS
SC Protection Unit [1]	1	0.8 x 1.3 x TBS	TBS	
Imager TES [1]	1	0.8 x 0.8 x TBS	TBS	
Sounder TES [1]	1	0.8 x 0.8 x TBS	TBS	
Imager IDB Cart [1]	1	1.8 x 1.2 x TBS	TBS	
Sounder IDB Cart [1]	1	1.8 x 1.2 x TBS	TBS	
LP area: Telemetry & Command Box	1	.5 x .4 x .2	20	120 Vac single-phase 20 A UPS
Isolation Transformer	1	1.4 x .6 x 1.1	1361	120/208-Vac three-phase 60 A UPS
MPR	1	1.3 x 1.2 x 2.2	910	

1. If the SC control room is not located adjacent to the SC processing room, this equipment shall be located in a separate room that is adjacent to the SC processing room.

6.7 LSP Performed Activities

The LSP, with assistance from S/C PO, shall mate the GLAST SC to the LV PAF. The LSP shall also move the payload in the spacecraft handling can from the PPF/HPF to the LP, hoist the payload in the handling can and mate the payload to the LV. The LSP shall encapsulate the GLAST SC in the LV PLF. Safety support shall be provided by the LSP during all SC and SC/LV hazardous operations.

6.8 Chemicals And Supplies

KSC-ELV PO shall provide certified SC propellants (TBD) in the proper grade and quantities. The LSP shall supply the following chemicals and supplies to support SC processing in the HPF and on the LP:

1. Gaseous Helium (GHe) per MIL-P-27407, Grade B
2. Gaseous Nitrogen (GN_2) per MIL-P-27401, Type 1 and/or type II, Grade B
3. Gaseous Nitrogen (GN_2) per MIL-P-27401, Type 1, Grade B, and certified to contain < 5 ppm helium
4. Isopropyl Alcohol (IPA) per TT-I-735
5. De-ionized water (H_2O) per ASTM D1193 type I

Exact quantities of the required chemical supplies will be provided no later than L-12 months. Additional quantities to be used at the LP shall be procured if contingency deservicing/off loading after the SC is fueled is a launch site requirement.

6.9 Propellant Sampling And Transportation

The LSP shall provide for transport of propellants from the storage facility to the HPR and to/from the HPR to the propellant test lab, and from the HPR to the propellant testing lab. The LSP shall provide for up to 25 samplings of SC fuel, oxidizer, and gases. License, permits, escorts, and notification shall be secured/executed by the LSP for these activities as required by US, DoD, NASA, national, state, and local directives. The LSP shall be responsible for disposal of waste through approved agencies.

6.10 Miscellaneous Services

6.10.1 Training

The KSC-ELV PO shall provide safety and procedural training to GLAST personnel required to access all rooms at the PPF, HPF, LP, the control room, Blockhouse, and the storage areas including propellant loading and deservicing operations training and the use of personal protective clothing used for SC propellant loading operations.

GLAST personnel handling the pyrotechnics shall be trained and certified prior to arrival to the launch site. GLAST personnel participating in the propellant loading/off-loading operations shall be SCAPE qualified prior to arrival at the launch site. The KSC-ELV PO shall verify that the GLAST personnel are certified prior to handing the pyrotechnics and prior to fuel loading operations at the launch site.

6.10.2 Licenses And Permits

TBD

6.10.3 Photographic Services

Routine delivery of up to 100 still photos and 8x10 color prints plus the use of video camera and recorder (1/2-inch VHS) and a photographer shall be provided by the LSP.

6.10.4 Documentation

The LSP, working with the required government agency(s), shall put the SC requirements into the appropriate documentation format and submit this documentation as required for launch approval.

6.10.5 Technical Shops

The KSC-ELV PO shall make arrangements for and provide S/C PO with unplanned technical shop support on a non-interference basis.

6.10.6 Range Support

The KSC-ELV PO shall coordinate and schedule all range support required for GLAST SC processing and launch.

6.10.7 Lightning Warnings

The LSP shall provide a public address warning of the Phase 1 and Phase 2 lightning warnings audible in all work areas where S/C PO personnel and hardware are present. The phases are defined as the following:

Phase 1: TBS
Phase 2: TBS

7.0 Safety

7.1 Safety Services

The LSP shall act as the GLAST project's agent for all system and range safety matters concerning the LV and GLAST. This shall include, but is not limited to, compliance with all required local and national codes and regulations.

7.1.1 Safety Documentation

The LSP shall supply all LV system safety documentation required for approval of the launch. The GLAST program shall supply the required SC safety documentation for submission to the safety approval authority(ies) by the LSP. All safety information that contains GLAST SC data or information which may impact GLAST SC processing operations shall be approved by the GLAST project prior to submission to the approving authority(ies).

7.1.2 Safety Meetings

The LSP shall support safety meetings with the GLAST project, LV and range safety approval authority(ies) as required to obtain launch approval.

7.1.3 System Safety Analysis

The LSP shall perform the System Safety Analysis for the interfaces between the GLAST SC and the LV. The LSP shall document the results of the interface hazard analysis in LSP Mission Unique safety documentation. S/C PO shall create all required SC safety documentation for delivery through the LSP (for cover letter only) to the safety approval authority(ies).

7.1.4 Safety Approval For Launch

The LSP shall request and obtain all safety approvals for the launch consistent with the Program Integrated Schedule. Copies of all approval letters shall be provided to the GLAST SC.

7.1.5 Safety Support

LSP safety personnel shall participate in and support safety related working groups, meetings and reviews, and monitor all hazardous operations.

7.2 Safety Of Design And Operations

7.2.1 Launch Site Safety Requirements

The LSP shall implement all safety criteria contained in applicable range safety regulations, as they apply to the GLAST/LV interface and facility processing requirements addressed herein. Additionally, the LSP shall implement all policy letters and program-unique safety requirements imposed by the safety approval authority(ies) as they apply to the GLAST/LV interface and facility processing requirements.

7.2.2 Commercial Facilities

If a commercial facility(s) is required for SC/LV integrated activities, the LSP shall implement the safety criteria contained in the commercial facilities operating procedures. If S/C PO deems safety criteria supplemental to the commercial facilities operating procedures necessary, the supplemental safety criteria shall be implemented by the LSP. The LSP shall ensure that the processing facility, whether commercial or government, complies with all applicable international, federal, state, and local laws/safety requirements which impact SC processing and transportation operations.

7.2.3 Contingency Deservicing

The LSP shall facilitate GLAST contingency deservicing as required by the launch site safety authority by providing GLAST requested access, in SCAPE or equivalent, to the GLAST fill and drain valves referenced in Section 3.2.1.6. Additionally the LSP shall coordinate and/or provide all facility/range assets required to support contingency deservicing operations including, but not limited to, hazardous vapor detection and sampling, LP propellant plumbing, containers, facility access for analysis and training, positioning of GSE, and propellant removal and disposal.

7.2.4 Emergency Services

The LSP shall make prior arrangements to ensure that emergency medical services and fire protection services are available at all facilities during the time S/C PO personnel are present.

7.3 Spacecraft Hazardous Systems

7.3.1 Pressure Vessels

The propulsion system consists of TBD and is pressurized at TBD psia. Additional information on the GLAST propulsion system can be found in the GLAST Propulsion System Specification document listed in the applicable document section.

7.3.2 Fluids

TBD

7.3.3 Propulsion

The propulsion system for GLAST shall use TBD as the propellant. Additional information on the GLAST propulsion system can be found in the GLAST Propulsion System Specification document listed in the applicable document section.

7.3.4 Ordnance

The GLAST SC shall use pyrotechnics to deploy TBD appendages from SC structure when the proper orbit is achieved. Additional information on the GLAST pyrotechnic devices can be found in the GLAST Mechanical System Specification document listed in the applicable document section.

7.3.5 Deployment Mechanisms

The GLAST SC shall use the LSP provided PAF separation system to separate from the launch vehicle at the appropriate time after launch. The GLAST SC shall use TBD systems to deploy the solar array panels and antenna(s) for on orbit mission support.

8.0 Security

LSP shall provide the GLAST project physical security during all operations from arrival at the PPF until launch. Security shall be consistent with the level of protection and degree of sensitivity required by any of the classified/sensitive/controlled/limited access government material contained therein and shall be consistent with the S/C PO TBD security plan. The LSP PPF/HPF security officer will supply a security plan to supplement the S/C PO plan when the GLAST SC are located at this facility(s). When the GLAST SC are located at the LP, the standard procedures in place to secure the LV and LP shall be verified by the LSP and S/C PO to be consistent with the S/C PO plan.

8.1 Access Control

S/C PO shall provide combination locks for use on entries to the PPF/HPF SPR hi-bay/airlock and SC control room. Entry for non-cleared personnel shall be by S/C PO escort. When S/C PO personnel are in attendance there shall be single-point access to the PPF/HPF hi-bay/airlock and the SC control room. Cleared personnel access lists shall be displayed at these single point entrances. When S/C PO personnel are not in attendance, the LSP PPF COMSEC-cleared security guard on duty at the front gate shall check of the locks and area. Discrepancies will be reported to the S/C PO COMSEC custodian.

9.0 VERIFICATION ACTIVITIES

9.1 Analysis

9.1.1 Mission Analysis

The LSP shall conduct performance and mission analysis studies required for proper implementation of the GLAST SC mission requirements. The results of these studies shall be reported in standard LSP Mission Analysis format.

9.1.2 SC Separation Analysis

A separation and post-separation analysis shall be performed by the LSP to verify that the design of post-separation maneuvers adequately preclude re-contact between the GLAST SC, and LV and that LV contaminates are directed away from the GLAST SC after their separation/and during CCAM.

9.1.3 Coupled Loads Analysis

The LSP shall perform a coupled loads analysis (CLA) of the dynamic environment imposed on the GLAST SC during the critical launch and flight events and shall provide the results to S/C PO for evaluation and for use in developing GLAST SC test plans. The analyses shall calculate GLAST SC loads, accelerations, deflections, and clearance loss for all critical launch and flight events. At a minimum, two load analysis cycles (preliminary and final) shall be performed for each GLAST SC. S/C PO will choose the damping and uncertainty factors at the time of each model transmittal for each cycle.

9.1.4 Critical Clearance Analysis

The LSP shall perform critical clearance analyses to verify acceptable hardware-to-hardware clearance for ground and flight events up to, and including, fairing jettison and during GLAST SC separation event. At a minimum, two critical clearance analysis cycles (preliminary and final) shall be performed for the GLAST SC.

9.1.5 Integrated Thermal Analysis

The LSP shall perform integrated thermal analyses of the GLAST SC/LV combination which shall include final pre launch operations (e.g. from payload encapsulation onward) and all phases of the mission (e.g. through GLAST SC separation) using S/C PO provided GLAST SC thermal math models. At a minimum, two thermal analysis cycles (preliminary and final) shall be performed. In addition, the LSP shall provide the following data for S/C PO to use to conduct its own thermal analyses:

1. The maximum dispersed FMH rate profile from PLF jettison through GLAST SC separation.
2. GLAST SC and PAF temperature profile from launch through GLAST SC separation.
3. Time history of predicted orbit parameters and attitude from injection into the initial transfer orbit through GLAST SC separation (especially at pointing/reorientation maneuvers).

9.1.6 EMI/EMC Analysis

An EMI/EMC analysis shall be performed by the LSP to verify that the GLAST SC/LV combination, and Range are compatible and that the SC RF energy exposure requirements will not be exceeded.

9.1.7 Ascent Venting Analysis

The LSP shall perform an integrated venting analysis to predict and verify PLF/PAF compartment pressures, depressurization rate, compartment pressure differentials, and internal pressure coefficients for the mission trajectory.

9.1.8 RF Link Analysis (TBR)

The LSP shall perform an RF link analysis to demonstrate that the RF system, from the SC omni antenna to the EGSE, provides positive link margins.

9.1.9 Contamination Analysis

The LSP shall perform a contamination analysis covering the period from payload encapsulation through post- GLAST SC separation maneuvers.

9.1.10 Post Launch Evaluation Report

LSP shall provide a summary post launch report to S/C PO approximately 30 days after launch. Quick look data will be provided in real-time.

9.1.11 Separation System Stress Analysis

A separation system stress analysis shall be performed by the LSP to verify that stress levels in and adjacent to the separation system are acceptable to S/C PO and that the SC-to-LV interface remains structurally intact during launch and ascent.

9.1.12 Acoustic Analysis

An acoustic analysis shall be performed by the LSP to verify the GLAST SC acoustic exposure requirements are not exceeded. This analysis may utilize an existing applicable analysis performed for a similar S/C PO SC.

9.1.13 Separation System Shock Analysis

A shock analysis shall be performed by the LSP to verify that the GLAST SC shock exposure requirements are not exceeded. This analysis may utilize an existing applicable analysis performed for a similar S/C PO SC.

9.2 Tests

9.2.1 Separation System Test

The LSP shall qualify the PAF/separation system operating envelope and quantify the PAF/separation system shock characteristics.

9.2.2 SC Environmental Tests

S/C PO shall provide to the LSP the environmental test plan that documents the GLAST SC approach for qualification and acceptance (preflight screening) tests. The intent is to provide general test philosophy and an overview of the system level environmental testing to be performed to demonstrate adequacy of the GLAST SC for flight (e.g., static loads, vibration, acoustics, shock). The test plan will include test objectives, test specimen configuration, general test methods, and a schedule. It will not include detailed test procedures.

Following the system-level structural loads and dynamic environment testing, test reports documenting the results will be provided to the LSP. These reports should summarize the testing performed to verify the adequacy of the GLAST SC structure for the flight loads. For structural systems that are not verified by test, a structural loads analysis report documenting the analyses performed and resulting margins of safety will be provided to the LSP.

9.2.3 Final mass and C.G. Measurements

The GLAST PO will provide to the LSP the final mass and c.g. measurement results of each GLAST SC taken after to mating to the PAF structure. The LSP shall evaluate these results to insure that the LV launch mass and c.g. requirements are not exceeded.

9.2.4 Matchmate And Separation System Shock Test

The LSP shall, with S/C PO support, conduct one matchmate test between the LSP provided PAF and the GLAST SC at S/C PO's facility for each SC launched. The test shall be conducted according to plans and procedures written by the LSP and approved by S/C PO. Each matchmate test shall use all electrical and mechanical flight hardware and shall include SC electrical umbilical connector continuity testing and a mechanical fit check inspection. For the first GLAST SC, the matchmate test shall include a firing of the flight separation system or other separation hardware to verify that shock levels are within the limits specified herein. The LSP shall provide all GSE and personnel necessary to handle LSP hardware. If possible, the matchmate shall be conducted by the LSP personnel responsible for that activity at the launch site. S/C PO shall monitor and measure separation shock parameters. A separation system firing for follow on SC may be requested on an as-needed basis.

9.2.5 Launch Site End-To-End Tests

Four tests shall be performed to verify the LV electrical characteristics prior to GLAST SC installation in the PLF. The tests shall be performed using S/C PO procedures approved by the LSP. Each test shall be performed with LV flight hardware, LSP and S/C PO-supplied test equipment:

1. Mission-peculiar harness test to verify the harness on the PAF before mating the GLAST SC to the PAF.
2. End-to-end test to validate the ground wiring pin assignments, continuity, and wire resistance requirements from the blockhouse to the SC/LV interface.
3. End-to-end test to validate the telemetry & command hardline links from the HPF control room to the SC/LV interface.
4. GLAST SC power test without the LV harness to validate the GLAST SC power characteristics using the SC MPR and the ground wiring from the blockhouse to the LV umbilical disconnect

9.2.6 SC/LV Buildup Interface Verification Tests

Four tests shall be performed using S/C PO procedures approved by the LSP to verify the LV and SC electrical systems interface correctly as they are assembled. Each test shall utilize flight LV and SC hardware as follows:

1. GLAST -to-PAF interface verification test (IVT) performed in the PPF/HPF to verify electrical wiring interface between the SC and PAF.
2. Encapsulated SC RF test performed in the HPF to verify the PLF portion of the RF re-radiating system or RF transparent window before transport to the LP.
3. SC-to-LV IVT performed on the LP to verify electrical wiring interface to the GLAST SC and to verify the full end-to-end ground wiring from the HPF and blockhouse.
4. GLAST SC RF test on the LP to verify the complete RF system

9.2.7 Flight Program Verification And Launch Rehearsal

A Flight program verification test and launch rehearsal shall be performed to verify countdown procedures, communication links, EMC, and Payload/LV compatibility during the countdown and subsequent flight sequence of events. Payload/LV flight hardware shall be used. NASA, NOAA, GFE Instrument Contractors, LSP and Payload personnel shall participate.

9.3 Environmental Verification

9.3.1 Quasi-Static Flight Loads Verification

The LSP shall demonstrate that the load requirements in Section 3.3.1 envelope the expected SC flight and ground levels.

9.3.2 Vibration Verification

LSP shall demonstrate that the vibration requirements in Section 3.3.2 envelope the expected SC flight levels.

9.3.3 Acoustic Verification

LSP shall demonstrate that the acoustic requirements in Section 3.3.3 envelope the expected SC flight levels.

9.3.4 Shock Verification

LSP shall demonstrate that the shock requirements in Section 3.3.4 envelope the expected SC flight levels.

9.3.5 Thermal Verification

LSP shall demonstrate that the thermal and humidity requirements in Section 3.3.5 envelope the expected SC flight levels.

9.3.6 Venting Verification

LSP shall demonstrate that the venting requirements in Section 3.3.6 envelope the expected SC flight levels.

9.3.7 Contamination Verification

LSP shall demonstrate that the contamination requirements in Section 3.3.7 envelope the expected SC flight levels.

9.3.8 EMI/EMC Radiation Verification

LSP shall demonstrate that the EMI/EMC requirements in Section 3.3.8 envelope the expected SC flight levels.

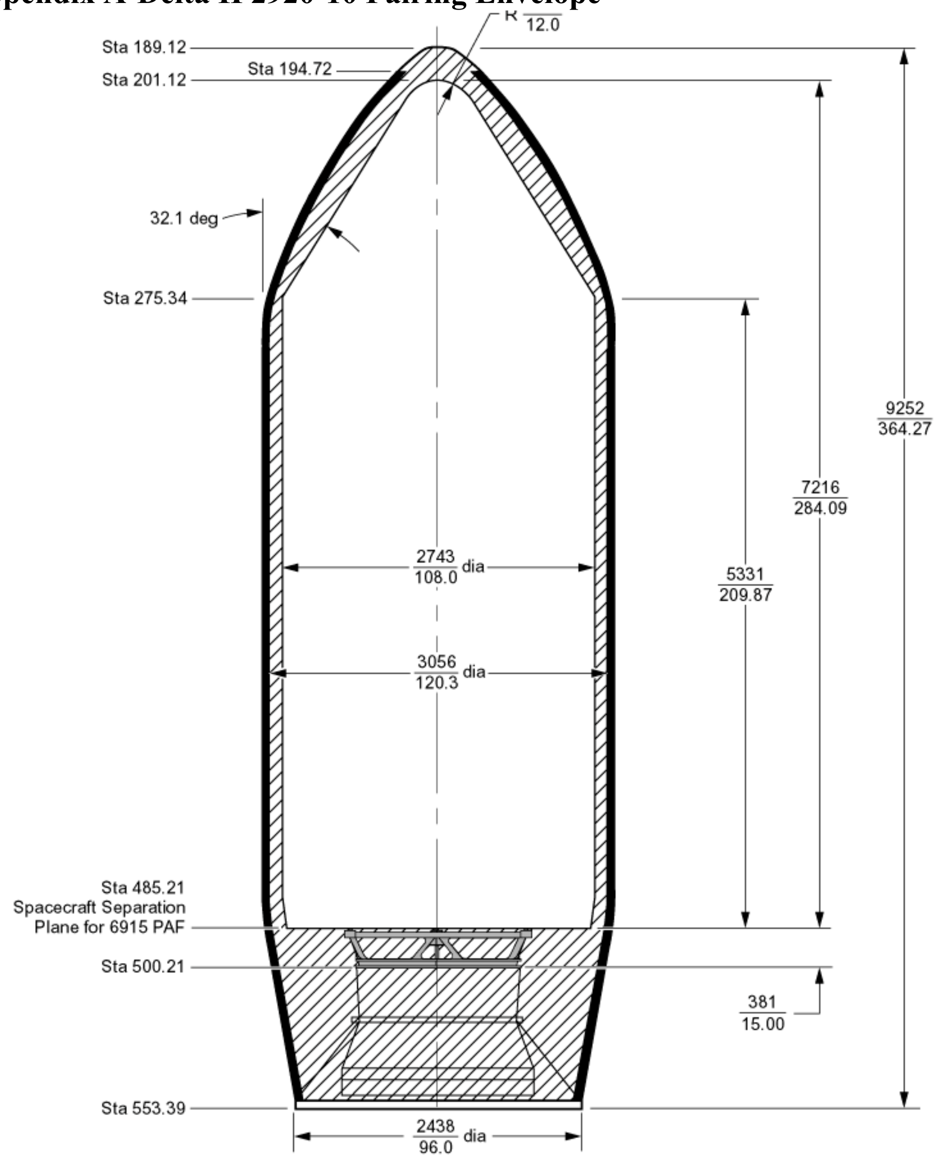
9.3.9 LV Flight Instrumentation

LSP shall provide the capability to measure GLAST SC ascent environments to provide verification that actual flight environments did not exceed the requirements contained herein. Environments to be measured include:

1. Acoustics (20-4000 Hz).
2. Interface loads (low frequency accelerations at the SC/LV separation plane, 0-100 Hz).

APPENDIX

Appendix A-Delta II 2920-10 Fairing Envelope



Inside Skin Dimensions

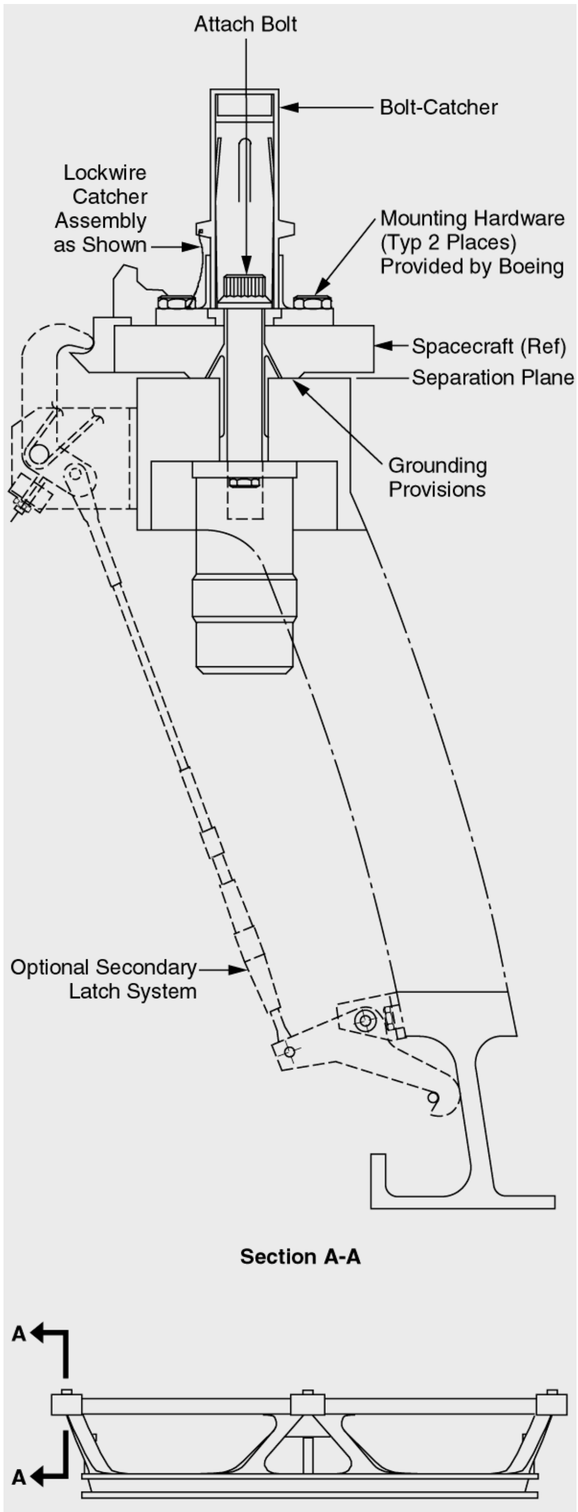
- Fairing Envelope
- Usable Payload Envelope
- Attach Fitting
- Acoustic Blankets

Notes:

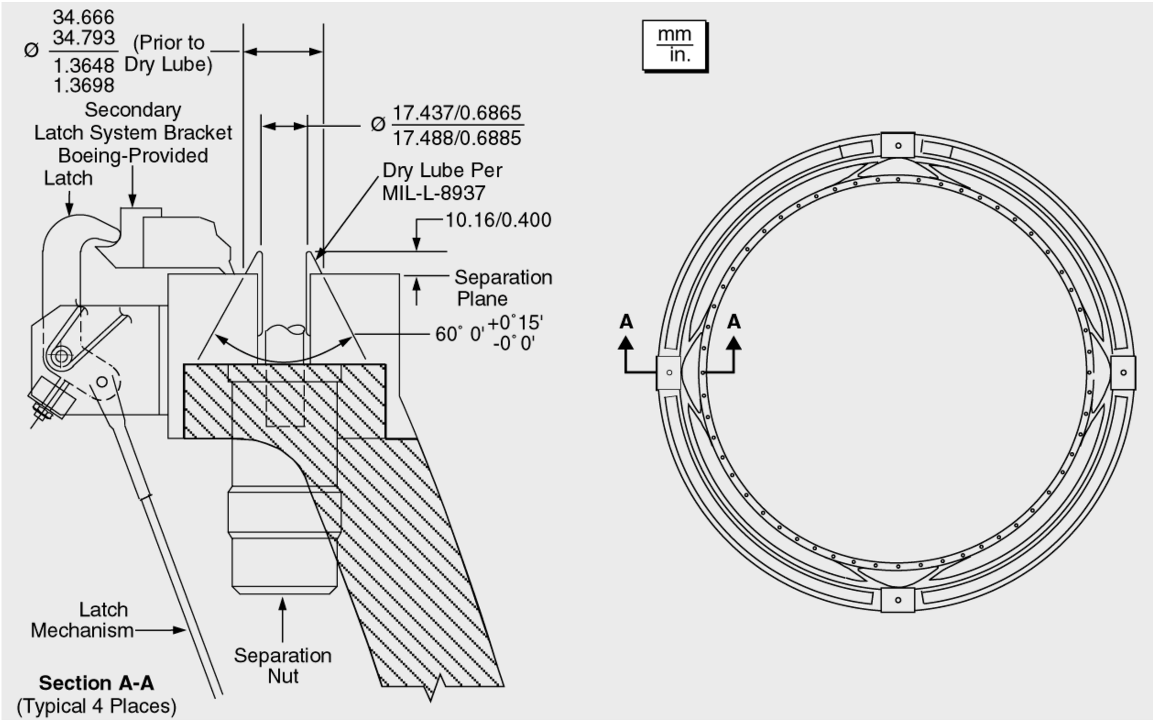
1. All dimensions are in $\frac{\text{mm}}{\text{in.}}$
2. All station numbers are in inches
3. Acoustic blanket thickness per Table 3-1
4. MDA requires definition of spacecraft features within 50.8 mm (2.00 in.) of payload envelope

Projections of spacecraft appendages below the spacecraft separation plane may be permitted but must be coordinated with the Delta Program Office

Appendix B1: 6915 PAF-Secondary Latch Assembly



Appendix B2: 6915 PAF-Detailed Dimensions



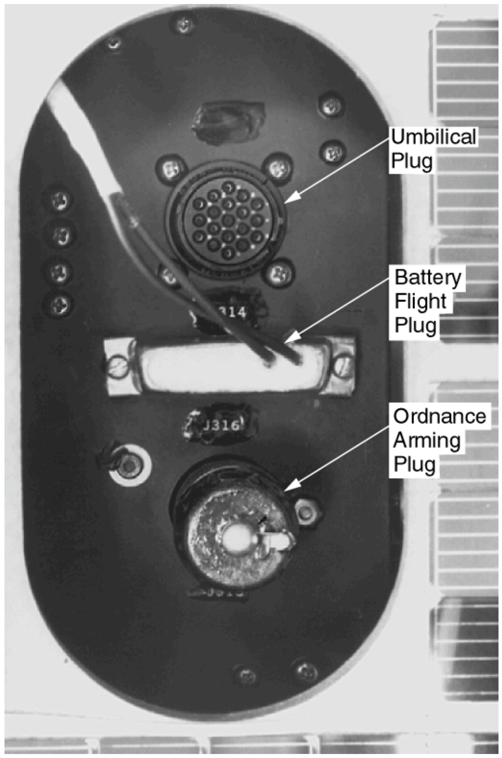
Appendix C- NASA Launch Site (NLS) Standard Services

Item No.	Launch Service Capability:	Delta II Two Stage Missions
Launch Timing		
1	Multiple re-launch attempts	Approximately 24 hours
2	Instantaneously launch windows	1-sec. Durations
3	Days between simultaneously planetary launch campaigns	10 days assuming typical integrated spacecraft testing and processing on separate pads
4	Trajectory targeting at multiple flight azimuths	Two flight azimuths per day with injection targets for a 21-day launch period
Launch Vehicle		
5	Standard Launch Vehicle	2330-10, 2420-10, 2920-10
6	Payload Adapters (PA) and separation system	6915 -Low tip-off
7	Spacecraft electrical interfaces	Up to two 37-pin spacecraft electrical cables interface from the fairing
Payload Separation System		
8	Redundant payload separation indications	Redundant switches
9	Payload Fairing (PLF)	10-ft diameter composite fairing
10	Payload Access doors (up to 3 doors)	24 inch diameter access door at negotiable locations
Misc. LV Information		
11	Flight Instrumentation	1 Temperature, 1 Acoustic microphone, 1 Pressure, 1 Accelerometer
12	Spin/despin capability	Minimum range of 0 to 30 deg/sec (5 rpm) with an accuracy of +/-1 deg/sec
13	Logo	2.44 m X 2.44 m (8 ft X 8 ft)

Item No.	Launch Service Capability:	Delta II Two Stage Missions
Program Management		
14	Design reviews-mission unique	For missions anticipating mission unique modifications not previously flown
Mission Integration Services		
15	Mission analysis	3 performance and guidance accuracy analysis; Final mission analysis; 2 payload/expended stage separation analysis;Payload fairing venting analysis; 3 payload fairing clearance analysis; Preflight controls and stability analysis; 3 coupled dynamic loads analysis; Integrated thermal analysis; RF link analysis; Payload/Launch Vehicle EMI/EMC and RF compatibility Analysis
Launch Site Support		
16	Launch vehicle preparation and launch	Eastern Range
17	Baseline vehicle support	Launch site baseline vehicle support begins at initial vehicle power application at Delta mission checkout (DMCO) and subsequently at the pad
18	Launch countdown and flight support	Two consoles in the engineering support area (ESA) in the launch control center for up to four NASA personnel
19	Launch dress rehearsal	Typically three days prior to launch
Launch Site Payload Support		
20	Payload processing facility	NASA payload processing facility must be a hazardous payload processing facility rated for both ordinance and propellant loading
21	Launch Site payload integration support clarification definition	The term "provision for" is defined as the contractor will enable NASA to perform the stated operation. The term "provision of" is defined as the contractor to provide the stated service
22	Provision for contingency off-loading of propellants	Off-load will be performed by the customer, using the customer's procedures

Item No.	Launch Service Capability:	Delta II Two Stage Missions
23	Provision of payload requirements	Power @ MST: 120 V, single phase; No DC power Power @ Blockhouse: 120 V, 60 Hz, 207 V 3 phase, 440/480 V 3 phase A/C, humidity and cleanliness: controlled to meet payload requirements in accordance to the contamination and environmental section below Provisions of Grade B GN2/GHe purge lines and control panels, if needed, through the fairing A/C duct into the fairing envelope to the payload purge connect within 5 deg. of the fairing sector centerline-no surrounding spacecraft intrusion within 30 deg. half cone angle separation clearance envelope at the mated purge connect
24	Provisions of payload protective cover	Class 100 K spacecraft environment
Contamination and Environmental Control		
25	Payload/vehicle integration environment	Pad white room: Temperature at 23.9 deg C, ±2.8; (75 deg F ± 5); Relative Humidity 45 ± 5%
26	Transportation environment	Handling can encapsulation: Temperature -1.1 to 32.2 deg C (30 to 90 deg F); Relative Humidity 30 to 50%; Dry gaseous nitrogen purge per MIL-P-27401C, type 1, grade A with a 0.3 micron filtration
27	Fairing environment	Payload fairing A/C and environmental shroud: Temperature 15 to 26.6 deg C, ±2.8 (60 to 80 deg F, ±5); Particulate class: 10K (verified/sampled at the duct outlet; demonstrated by test)
28	Fairing internal surface cleaning	MIL-STD 1246C Level 750A
29	Cleanroom garments	40 maximum for 100K class clean missions to be available at any given time after spacecraft erection
30	Analytical models and support services	Provide models and data in Boeing standard format for the configuration authorized. Provide 100 hours of engineering support for clarification, description, and/or coordination.

Appendix D1- Typical SC Umbilical Connector Interface Between SC and LV



Appendix D2 Blockhouse to Fixed Utility Tower Wiring Line Resistance (one-way)

Location	Function	No. of wires	Fairing on*		Fairing off**	
			Length (m/ft)	Resistance (ohm)	Length (m/ft)	Resistance (ohm)
CCAS	Data/control	60	348/1142	2.5	379/1244	3.7
CCAS	Power	28	354/1160	1.3	385/1262	1.8
CCAS	Data/control	24	354/1160	6.2	385/1262	7.3
VAFB	Data/control	60	480/1576	3.7	511/1678	4.9
VAFB	Data/control	40	480/1576	5.5	511/1678	6.6
VAFB	Power	6	480/1576	0.9	511/1678	1.4

*Resistance values are for two parallel wires between the fixed umbilical tower and the blockhouse.
**Resistance values include fairing extension cable resistance.